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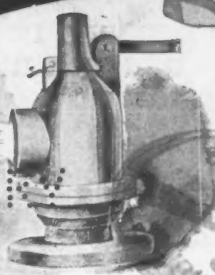

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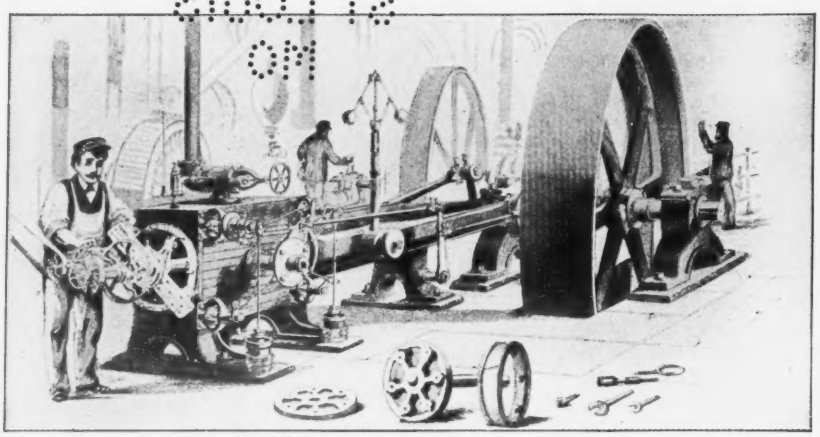

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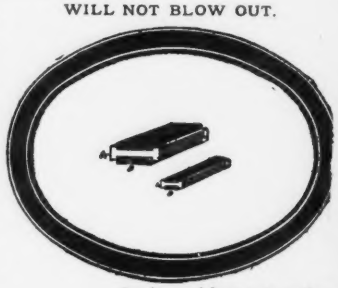

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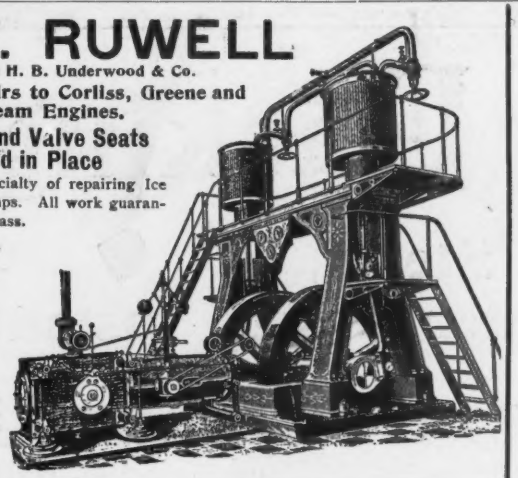

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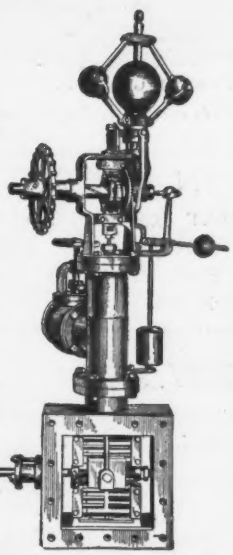

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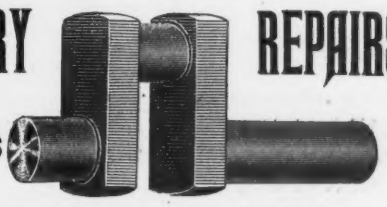

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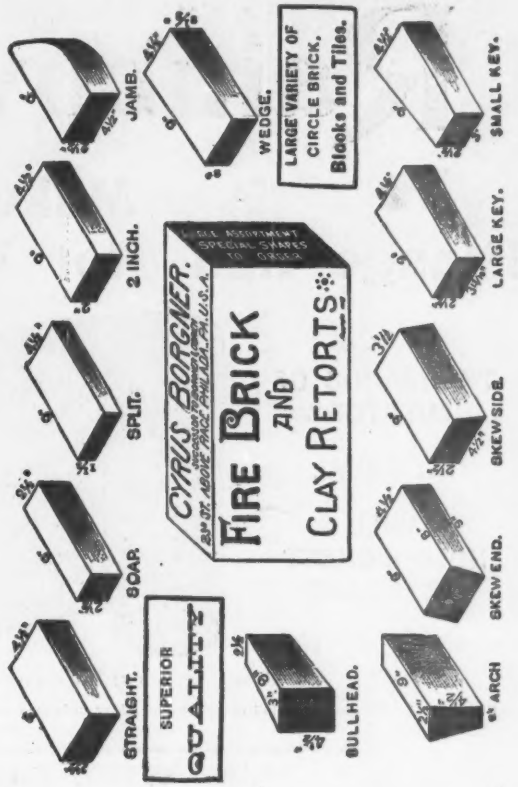

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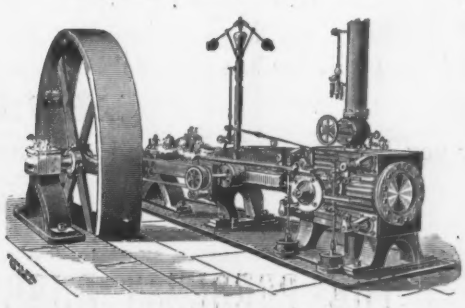

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The Practical Engineer

THE OFFICIAL JOURNAL OF THE AMERICAN ORDER OF STEAM ENGINEERS.

213086

Devoted to the Interests of Stationary Engineers.

VOL. VI. PHILADELPHIA, FEBRUARY, 1902. No. 1.

Concerning the Organizing of Engineers.

Despite the earnest labor of the many technical journals and the constant endeavor of our engineering organizations to obtain an equable engineers license law which might be operative throughout this state and others, we are confronted with almost daily loss of life and property from boiler explosions. This argues either a wilful disregard of necessary precaution on the part of those in charge of power machinery, etc., or a lack of knowledge upon what they do not seem to be inclined to improve.

THE PRACTICAL ENGINEER has always the education and the advancement of the engineer in view, and hence his welfare, and it is for this purpose that we take this time and opportunity to show engineers the necessity of license laws which will govern the engineering profession alike in every respect, and in every State or part of the State; of course we do not hope to be able to effect this law everywhere just yet, but the crying need of such a law is so apparent in Pennsylvania that we will deal with that State here.

In Philadelphia a boiler explosion is a rarity indeed, this is a condition of affairs which certainly speaks well for our present license law. Now, is life or property any less valuable in the country districts or our second class cities than it is in Philadelphia? Certainly not! Then why permit conditions which endanger life and property in one part of our State and not in another? Undoubtedly there will be an effort made at the next session of the legislature to establish a fair and uniform state license law. In this matter THE PRACTICAL ENGINEER takes the liberty of advising all engineers to organize with the A. O. S. E., and thus assist in placing before the legislature a license bill of unquestioned merit, as good, or even better, than our Philadelphia law, the passing of which the American Order of Steam Engineers justly assumes the credit for. But municipal laws, be they ever so good, are not desirable where it is possible to obtain a state law.

In the first place they serve to obstruct the future pasage of a state law. The inspectors, or examiners, placed in control of municipal laws are likely to exert themselves to prevent the passage of a state law in the fear that they would lose their positions, while the higher municipal authorities and political "whips" of any municipality having a license law would naturally oppose the passage of a state law in order to retain for themselves the distribution of the revenue and "patronage" thus created. This is by no means a theory, but a fact, which has several times been demonstrated to the embarrassment of those interested in efforts to have state laws passed. Moreover, a bureau or department for the licensing of engineers under state control, is less likely to be influenced by small politics; fewer licenses are apt to be granted upon political recommendations, or for personal reasons, than when the same offices are under municipal control.

However, the State of Pennsylvania is now comparatively free from the "municipal law" handicap, Philadelphia being the only city having such a law, and a vigorous effort by the engineers of the state, harmoniously combined, will doubtless induce the members of the next legislature to cast a favorable vote for an equable license bill that will serve to protect the interests of the engineer, the employer and the public.

Such a bill will doubtless be presented, and its passage urged by the American Order of Steam Engineers, with every prospect of success, but the order will welcome the assistance and support of every engineer in the State having the interest of his profession at heart, and in order to make this support doubly effective, it is desirable that the engineers of the state be organized under the jurisdiction of the order. New councils should be formed in every town and industrial locality, so that each section of the state may send a chosen representative, and thus have a direct part in framing the bill to be presented.

THE PRACTICAL ENGINEER will be glad to furnish any information desired to further the success of the movement.

British Manufacturers are Recognizing the Merit of Standardizing.

The unquestionable supremacy and reliability of American manufacturers and American material, is undoubtedly due in a large extent to the constant and mutual desire and co-operation of our producers to establish and fix a reliable set of standards in all classes of goods, thus obviating the necessity of constantly changing patterns, dies and machinery or other material in the manufacture of their respective output.

Let us take for instance the British Isles; in that country the manufacturers have to contend with 171 different sections of standards to compare 49 in America, in the matter of screw threads and standard gauges alone. Consequently the British manufacturer has four or five times the dies and patterns to carry, with a corresponding increase in draughtmen and other like employes engaged in the formulation of plans. Then again it seems to be the desire of most of the railroads and tramways to demand an entirely different gauge and pattern in their general stock from that of their competitors. In England alone there are 70 different gauges of railways rails, think of that in competition with our own almost universal system in that line.

All of these conditions, of course, force an enormous expense upon the producer in the matter of increased machinery, dies, patterns, etc., which can only be met with a corresponding increase in the gross price.

The American manufacturer not having all this to contend with can readily produce an article of better grade and workmanship (with all the parts universally interchangeable) than our British cousins can hope to attain until they adopt a universal system of some kind. This is a feature that has of late come to be recognized by the British manufacturers as a necessity if they want to continue in business. To attain a profitable and equable standardization in the British Empire and territories there has recently been appointed a committee composed of some of the best known manufacturers and mechanical engineers in that country; their duties will be to make a study of general conditions in their own country and abroad, and then pass upon and adopt as far as possible a more universal system.

The members of "The British Standards Committee," as it is designated, are: James Mansergh, late president of the Institute of Civil Engineers; Sir Benjamin Baker, Sir John Wolfe-Barry, Sir Frederick Bromwell, Sir Douglas Fox, George Ainsworth, William Dean, Albert Denny, James Allen MacDonald, E. Winsor Richards, James Riley, Proffessor W. C. Unurin, and Dr. J. H. Tudsbury.

What causes Boiler Explosions.

The frequent disasters throughout the country during the past two months has attracted the general attention to boilers, of boiler makers and boiler care takers. The terrific force with which the explosions have occurred has caused great loss of life among the people immediately around the exploding boilers, and many who were not killed have received injuries such as to make them cripples for life. Of course so long as steam boilers are used, just so long will we have boiler explosions, but undoubtedly the majority of such occurrences superinduced by either lack of good horse sense by the attendant or through the crystalization of the shell metal, a matter that is seldom determined until too late.

One of the causes of explosion seldom thought of, is through the safety valve. One must bear in mind that water is practically a solid; you have water in a boiler and you boil it. It boils at 212°. Now you increase the pressure and it will take a much higher temperature to make it boil, this increases the density. If you release the pressure too suddenly you begin to stir up trouble; if the release continues every drop of water in the boiler will almost instantly come to a boil owing to quick reduction in pressure and corresponding temperature. When the drops boil they take up seven times as much room as they did previously. This causes what is known as water ram. Now let the safety valve stick, say until the steam raises 10 or 15 pounds above the set of the valve; finally the valve releases, then there is an awful rush of steam with a corresponding eruption of the water inside. A condition which very few boilers are able to withstand, consequently an explosion occurs.

Recently a government test was made of a boiler, steam was run up to 600 pounds pressure and the boiler just went humming like a top, but it did'nt burst. The next day they ran steam into her up to 300 pounds, and then the engineer briskly pulled the safety valve, and when the men came out of the safety tower there wasn't a piece of the boiler in sight; it simply blew into fragments, thus proving that water ram will cause a boiler to explode with the most disastrous effects.

Another cause of explosion, as before mentioned, is crystalization of the metal, which simply means a change of condition from that of steel to an ordinary grade of cast iron, this change is effected by burning, usually caused by the presence of scale on mud. The fact of oxidation or crystalization existing is very hard to determine, because there is no wasting away of the metal or other outward sign of disintegration. Thus, it is usually found out only through an explosion.

Another, and probably the primary cause of a large number of explosions of boilers is that of rivet shear, or rivet weakness. This is the result of excessive contraction and expansion superinduced by sudden and too great changes of pressure, or an irregular change of the water line.

Four boiler explosions within a period of less than five weeks, two of them in Pittsburg, Pa. (December 2c–21st); one in Detroit, Mich. (November 26th), and one in Macon, Ga., January 2d; caused the violent death of thirty-nine persons and the serious injury of eighty more, entailing a property loss of three hundred thousand dollars, not to speak of possible damage claims which may be entered.

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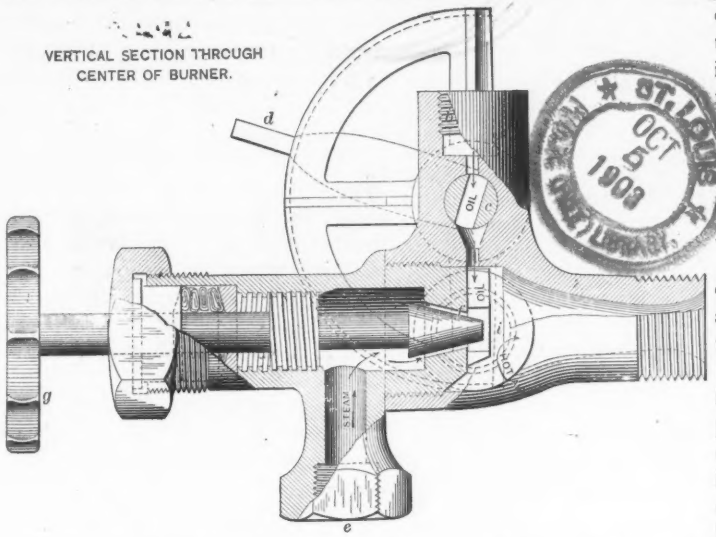
Probable Effects of Recent Discoveries of Oil.

T. Duncan Just.

The recent discoveries of oil in such enormous quantities and at such widely divergent places, is likely to cause an almost complete change in the methods of heating throughout the world. Certain of the advantages that the use of liquid fuel suggests are so obvious that they scarcely need be mentioned. For instance, the great ease with which such fuel can be handled, and the great saving of labor in the fire room, combined with many other reasons which will readily occur to the reader.

VERTICAL SECTION THROUGH CENTER OF BURNER.



St. Louis OCT 5 1903

Heretofore all of these virtues of petroleum as a fuel have been eclipsed in the eyes of the manufacturer considering its use by the matter of cost, for it is certain that in this great country of brains the mere matter of a suitable burner, or a satisfactory boiler setting, would, or could not stand in the way of a fuel so rich in energy and so full of promise in other respects.

Now since every day we have reports of new and valuable discoveries of oil, great interest will undoubtedly be at once manifested in its uses; for the great supply promised will unquestionably remove the only practical obstacle preventing its use becoming very general in our manufacturies.

Among the many advantages of this source of power, which will likely first be considered, are those of more uniform heat, more constant pressure of steam, no ashes, clinkers, soot or smoke, and consequently clean flues, and the saving of wear and tear on the plates, effected by the uniform distribution of heat; all this, combined with the labor saved, will of course be the first to appeal to the user; the benefits accruing in favor of the fireman we will deal with later.

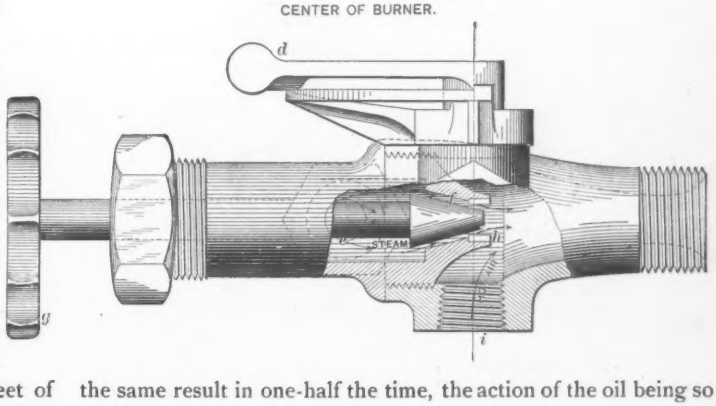
The methods used in the United States at present for burning crude petroleum is practically the same as those adopted in Russia, on the Caspian Sea, where the utility of oil as a fuel is very profitably demonstrated by a vast fleet of vessels using it. The principal of these methods is an atomizer or "pulverizer" for introducing the oil into the furnace, the oil being injected by a blast of steam or air, although it is sometimes thrown in by centrifugal force also. Thus it may be said, in general, that the mechanical obstacles are practically removed. Now then with all prospect of the removal of the obstacle of cost, we have only to bear in mind in burning crude oil, first the liability to fires and explosions from the ignition of vapor given off by the oil, or from error in the management of the "pulverizer" and furnace; second, the liability of loss of efficiency through imperfect combustion; and third, and paramount, the danger of imparing the boiler.

However none of these are very serious difficulties, provided the plant is managed intelligently in all its details. The fierce flame from the burner should not be allowed to impinge directly upon nuts or rivet heads or the ends of riveted flues or upon other portions of the boiler that might become overheated and burned, and care should also be exercised to prevent cold draughts of air from striking the heated plates, from the fire doors or elsewhere, since a sudden chill of this sort is likely to strain the boiler. Sheets are not infrequently cracked, in the Caspian Sea service, through this neglect of precaution, and while the danger is perhaps less in the stationary service in this country, it should nevertheless be borne in mind. All these points are a matter of detail which of course the fireman will be obliged to aquire knowledge of in order to obtain the proper results both in the interest of himself and his employer.

Now let us presume that oil is the most economical to the consumer; where does the fireman benefit by its use? The answer is easy, and the benefits so varied and numerous that one could almost write a volume on this question alone. 1st we will begin with one (any one) of our city office buildings, or crowded factories, and where is the usual place apportioned to the boiler room? Why of course the most out of the way, impossible of approach, spot in the whole building; with the coal bunkers usually so far away that every shovel full of coal will have to be handled on the wheelbarrow. The ashes and dirt have to be handled likewise work of the hardest kind, too. Now introduce the oil burner, in their removal. All this requires of the fireman work, and and you at once dispense with the above-mentioned disagreeable features while you do not detract in any way from the use of the boiler.

Then again the fireman will benefit in a saving of hours in labor, instead of having to report a certain length of time before starting up, in order to get up steam, he will be enabled to attain

HORIZONTAL SECTION THROUGH CENTER OF BURNER.



the same result in one-half the time, the action of the oil being so much more responsive.

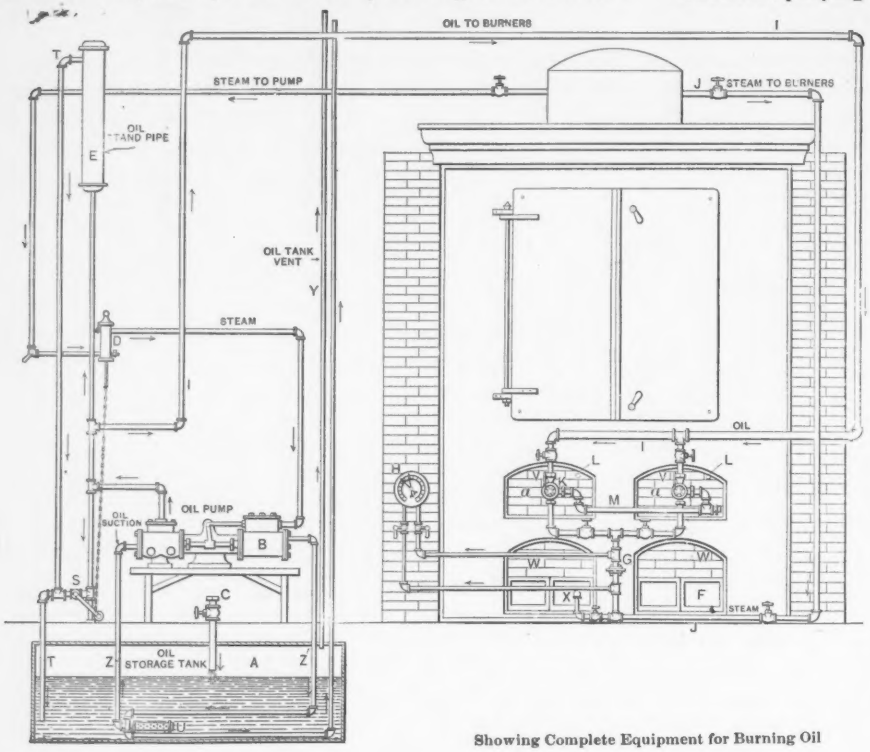
Second, and of much more importance to the fireman, is its easy adaptibility to boats, for firing on the ocean steamers is in its present form one of the cruelest labors that man is called upon to perform; for instance the stoker comes to work wearing only a thin undershirt, light trousers, and wooden shoes. Usually each man has to attend to four furnaces. He first has to rake open the doors of the furnace in a room—or space it would bet-

ter be termed—in which the thermometer registers 130 to 150 degrees F. He then begins at once, while he is fresh, to clean the fires; spending several minutes at each, the temperature by that time has probably risen to nearly 200 degrees where he is working (within 12 degrees of boiling). He then dashes to the air pipe, takes his turn at cooling off, and waits a call to his furnace, which speedily comes.

When the "watch" is over, the men shuffle off, dripping with sweat from head to foot, through long cold galleries to the forecastle, where they "turn in" for eight hours. Four hours of blistering heat and eight hours sleep make up the routine of the firemans life aboard ship.

Now you will say, "well they won't need firemen if all that is true, or at least they will be enabled to get along with one-half the number;" but therein you will make a mistake, for while the heat will be reduced, through the lack of opening and closing furnace doors, and many other undesirable features done away with, yet the oil burner will need the most constant attention, and expert attention at that, but not of the back aching, back breaking kind.

From all this it can be readily concluded that the discoveries of oil will be mutual benefit to the employer and the employed.



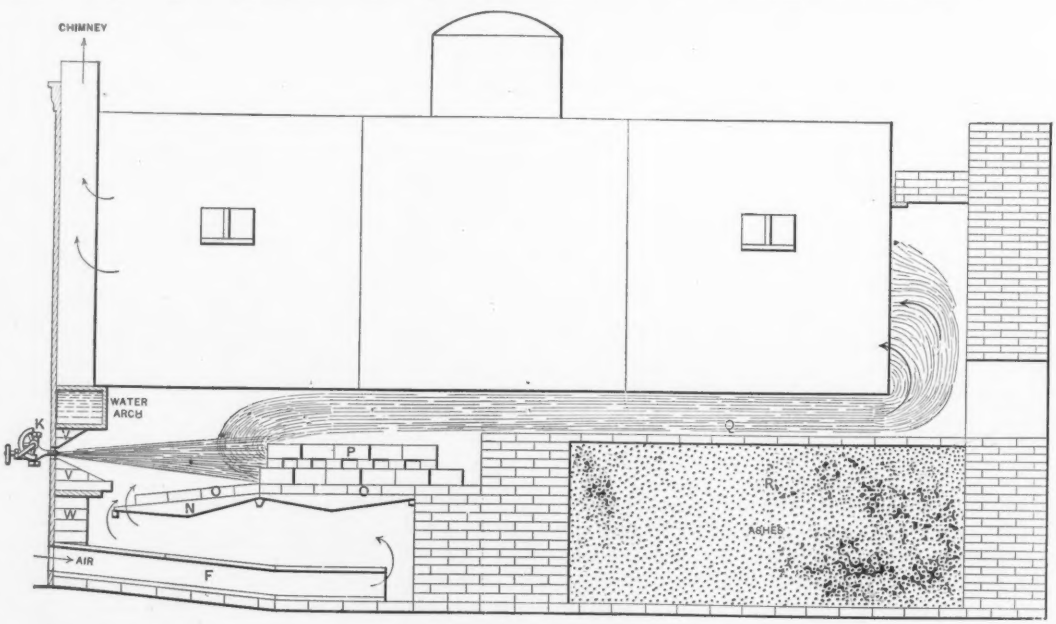
Showing Complete Equipment for Burning Oil

It would not be amiss in either the manufacturer or workman to keep well up with this subject, for undoubtedly oil as fuel will soon be a question of consideration for both to take up.

The accompanying cuts illustrates the usual type of burner used for boiler work. In order to ensure perfect combustion, the air supply should be regulated so that the flame-sheet is of uniform, intense brightness, without bluish streaks. The atomized oil should thoroughly mingle with the air that is admitted for combustion, and the arrangement of the furnace should be made so as to ensure burning the oil entirely before it comes in contact with the comparatively cool boiler plates. With the burner shown in the accompanying illustration all danger from having the flame impinge directly upon the plates is obviated, and also a more perfect mixture of air and oil directed against a wall of fire-brick, and sometimes this idea is carried out more elaborately by directing the jet into a fire-brick chamber, from which it can emerge only after an entire change in its direction.

Air enough to ensure complete combustion is admitted from the cleaning door at the rear, through two channels or conduits, arranged with a damper for regulation of the supply.

One of the main difficulties encountered in using crude oil as fuel is the starting of the fire after the plant has been shut down for a time; because the oil atomizer cannot be set in operation without steam to operate them. Usually a small auxillary boileris provided, that may be fired with coal or wood, and thus obtain the supply required, until the main boiler can be gotten under way.



Showing Burner in Operation

Whatever fate may be in store for the speculator in, or producer of oil, the industrial world may derive some benefit from this superabundance. It has been proved that oil is a good fuel. One pound of it, of average gravity, free from sand, will

evaporate as much water in a steam boiler as will two pounds of anthracite, two and one-fourth pounds of bituminous, or three and one-half pounds of lignite. Speaking in round numbers, six barrels of oil weigh a ton, and in actual test on a steamship of 100 horse-power and 800 tons burden, it was found that the consumption of oil was three and one-half tons per day, or twenty-one barrels, as against a daily consumption of nine tons of coal.

If the problem of cheap fuel is to be permanently solved along these lines, the statement of the president of the Atchison, Topeka and Santa Fe Railway—which is gleefully pointed to by the speculators as a convincing reason why oil stocks are good—will become important. He says that twenty-five passenger and freight engines on a thirty day's run used 2,077 tons of coal and covered 80,063 miles, or about forty-two miles per ton. Oil at $1.35 per barrel would at this figure cost 14.4 cents per mile, against 23.2 cents per mile for coal. Experiments with the biggest engine of the International and Great Northern Railway Company have demonstrated that on a hundred mile trip 26½ barrels of oil were consumed, whereas the same run with coal would require six and one-half or seven tons of the best lump coal. The coal at $3.75 per ton would cost $26.25 and the oil at 60 cents per barrel $15.90, showing a saving on the trip of $10.35.

These figures are, however, subject to revision. Coal can be purchased in many sections for less than $3.75 while it is doubtful if the oil can be had at 60 cents a barrel at any considerable distance from the source of supply.

The Export Oil Company, of Beaumont, Texas, has been making a series of tests of Texas oil for fuel at the Hygeia Ice Company's plant, No. 544 West Nineteenth Street, New York. A 150 horse-power boiler was fitted up, as far it was possible to do so, for the burning of the crude oil. Tests were made with reference to the capacity of the oil for fuel; the rapidity which steam could be raised and evaporative tests. These were followed by similar tests with coal for fuel. The matter aroused a great deal of interest, and the plant was visited by many representatives of the press, manufacturing concerns and members of the American Society of Mechanical Engineers.

It was claimed by those in charge that the oil did everything that was claimed for it. One statement was, that apparently two and one-half barrels of crude oil are equal to one ton of coal. Another statement was that they could lay the oil down in New York at a cost of 75 cents a barrel or less. The tests were made under the supervision of Prof. James E. Denton, of the Stevens Institute of Technology.

The known facts in the case seem to be that there is an unlimited supply, that it is consequently very cheap; that coal is getting more expensive; that if it can be used successfully it will save the expense of handling coal and ashes.

The results of this test are practically all in favor of oil and will bear more than the average attention. A glance at the following table will show the results of the tests in full:

One pound Texas Crude Oil evaporated 16 pounds water at 212° F.

One pound Buckwheat No. 1 Anthracite Coal evaporated 9 pounds water at 212° F.

Therefore 1 pound Texas Oil equals 1,773 pounds coal in evaporative results.

1,260 pounds Texas Oil equals 2,240 pounds or 1 long ton coal.

1,260 pounds Texas Oil, or 163 gallons equals 1 long ton coal.

One ton No. 1 Buckwheat Coal costs American Ice Company, delivered $3.25; add stokeage and disposition of ashes 15 cents, making total cost coal $3.40 per ton.

163 gallons Texas Crude Oil at 1¾ cents per gallon, or at a rate of 73½ cents per barrel, cost $2.56 per ton, making a saving of oil over coal of 44 cents per ton.

In addition Texas Oil developed 200 to 205 horse power, as against 125 to 130 horse power, being highest horse power attainable with coal.

An Effective Means of Saving Cylinder Heads.

Taking the results of the most reliable tests and it is found that steam as it comes from the boiler rarely contains less than 4 per cent. or 5 per cent. of moisture and frequently contains as much as 15 or 20 per cent., and sometimes more than that.

Undoubtedly this feature of wet steam is one of the most vexing problems that the engineer has to contend with. First, in the question of economy, and greater than all, in the constant menance from that source to his engine and pump cylinders, particularly when high speed engines are in use. Accidents may arise from excessive condensation in long piping, from foaming in the boilers, or from the presence of water pockets in the steam line (which every one should take good care to avoid having).

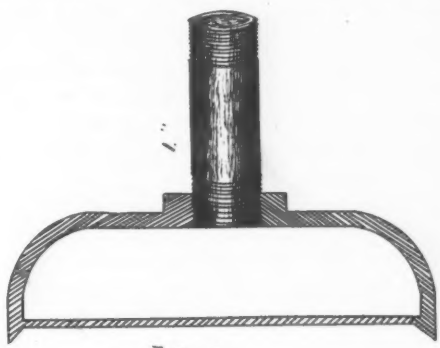


Fig. 1

The principal reason for wet steam, however, is not very difficult to understand when one watches water boiling rapidly in an open vessel. The bubbles of steam arise to the surface and break through the surface film or skin of the water with considerable violence. In the average boiler this bursting effect often times reaches the volume of minature explosions, through the fact that there is usually a greater scum on the surface than one would at first imagine. The steam bubble then in pushing through this matter is held in a certain subjection until its final release, which, of course, is effected only with violent erruption, this throw a fine spray of water into the steam and will readily assimilate with the same.

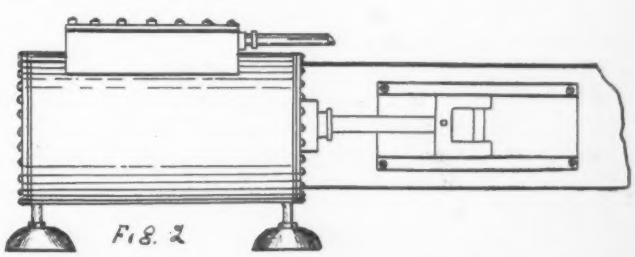


Fig. 2

In modern boiler practice, where water tube boilers are used with small steam space, small liberating surface, small volume and rapid circulation, the tendency is to produce wet steam. This has led to the incorporation of many different devices both in and out of the boiler to effect a separation of this moisture from the steam. But in spite of this, there is always a great deal

of water finds its way into the cylinders with oftentimes dangerous results.

The following cuts will illustrate to the reader a very simple and extremely cheap device which can be attached to most any engine cylinder with little trouble and not much expense. It is simply a "bursting relief" attached to both ends of the cylinder. Fig. 1 shows a fair description of the device itself while Fig. 2 shows a cylinder with the attachment complete.

The idea is that a cup be cast and then turned up to such a thinness that any unusual or sudden concussion will force the bottom out of it instead of forcing the head out of the cylinder. A little study will easily teach the engineer just how thick to have the cup bottom, and as they are very inexpensive one can afford to have several on hand for replacing bursted ones.

With one of these devices attached to an engine, there cannot be much danger of strained cylinder heads, and anyone can with little trouble attach them.

The Chemical Composition and Calorific Value of Coal.

By T. H. Reardon.

The principal constituents of coal are carbon, hydrogen and oxygen. Sulphur is present, particularly in soft coal as an undesirable constituent, its heat value being of no particular consequence, when considered in connection with its objectionable features as a corrosive agent.

Nitrogen appears also in the analysis of nearly all coals, and is usually present in about the proportion of 2 per cent. This element is not objectionable except that it, of course, evolves no heat, while its temperature being raised to that of the flue gases it carrries off heat that is evolved by the other constituents of the coal.

Oxygen is always present, varying in amount from 3 to 13 per cent. The proportion of oxygen is much greater in bituminous or soft coal than it is in the different varieties of anthracite The percentage of this element in a good sample of anthracite coal being 2.97, while in three samples of bituminous it was found to be 7.89, 8.09 and 12.88 respectively.

Oxygen, of course, evolves no heat, and furthermore during its expulsion it takes up one-ninth of its weight of Hydrogen forming water, which requires a certain amount of heat for its vaporization.

The amount of ash in coal deserves particular attention, and as its amount varies greatly in different coals, the quantity in any particular case must be determined experimentally.

The analysis of the following samples gave 1.03, 2.70, 1.61 and 2.07 per cent. respectively. Only one sample of anthracite being used, which gave the figures 1.61.

By adding up the percentages of the elements that possess no heating value, and subtracting their sum from the weight of coal taken, it is not a difficult matter to ascertain the net amount of combustible in a sample of coal, when the analysis is given and the amount of moisture is stated, which, of course, should always be deducted.

The percentage of carbon in the above samples was found to be 81.41, 78.57, 80.07 and 90.89, respectively, the figures last given referring to the sample of anthracite. The percentage of hydrogen, figures in the same order, are 5.83, 5.23, 5.53 and 3 28. The reason why a good sample of soft coal possesses greater heat value than the same weight of hard coal or carbon should now be apparent, for as the proportion of one constituent increases, the proportion of the other constituents must necessarily decrease. As hydrogen has a heat value about 4.5 times greater than carbon, it is evident, without any calculation at all, that if it is present in relatively large amount, that the proportion of heat evolved will be much greater. The proportion of hydrogen that unites with the oxygen in the coal and forms water therewith without evolving heat, is not so important as it may at first appear and is best illustrated by means of an example. Taking the pound of coal that contains .0583 pound of hydrogen and .0789 pound of oxygen, we have as the result .0583 minus .0789/9 equals .0495 pound of hydrogen available as a producer of heat. The weight of water formed is, of course, equal to the weight of hydrogen and oxygen shown in the above example namely, .0789 plus .0789/9 equals .0877 pounds of water formed. The temperatures of the water at first is the temperature of the coal as it enters the furnace. The water is heated and converted into steam having a temperature corresponding to the temperature at which the flue gases escape.

The calculation of the heat carried off in the steam would be a rather difficult matter, as the steam is in a superheated condition. The heat units evolved by one pound of dry bituminous coal having the following composition: carbon, 81.41 per cent.; hydrogen, 5.83 per cent.; oxygen, 7.89 per cent.; nitrogen, 2.05 per cent.; sulphur, .75 per cent.; ash, 2.07 per cent.; will be shown.

The following values in heat units will be used in the calculations that follow: hydrogen, 62,500; carbon, 14,500; sulphur, 4070; then we have—

Carbon, $.8141 \times 14{,}500 =$	11,804	heat units.
Hydrogen $(.0583 - .0789/9) \times 62{,}500 =$	3,095	" "
Sulphur, $.0075 \times 4070 =$	30	" "
	14,929	" "

The sample of anthracite will be considered in the same manner: composition; carbon, .9089; hydrogen, .0328; oxygen, .0297; nitrogen, .0083; sulphur, .0091; ash, 0161.

Carbon, $.9089 \times 14{,}500 =$	13,171	heat units.
Hydrogen $\left(.0328 \text{ minus } \frac{.0279}{9}\right) \times 62{,}500 =$	1,844	" "
Sulphur, $.0091 \times 4070 =$	37	" "
	15,052	" "

It will be noticed that the particular sample of anthracite taken for illustration possesses a greater heating value than the sample of bituminous, but this result is due to the fact that the oxygen and ash are both present in a relatively large amount, and that the quantity of net combustible is necessarily reduced on this account.

Bituminous coal, however, of good quality in which the elements that yield no heat are present only in reasonable amount, will be found to have a considerble higher heat value than the different varieties of hard coal, and on account of the ease and facility with which the fires may be banked and controlled, its use is preferred and even necessary in many cases.

Official confirmation has been given the report that the arbitrator on the projected electrification of the underground railroads of London has decided in favor of Chas. T. Yerkes. In anticipation of this result Mr. Yerkes has already given the British Westinghouse Company a big contract for engines, generators, etc., for the generating station. This material will come from Pittsburgh, as the Westinghouse Co.'s Manchester Works, are not yet completed.

Compound and Shunt Motors.

By Arthur Atwater Kent.

A matter which receives less consideration than it ought is the question of using compound and shunt motors in their proper places. The shunt motor has its place, but few realize the advantages of the compound machine for a variety of works. The shunt machine is constant, almost rigid in its speed at any load, due to the fact that its field strength is constant, and as the load is thrown on the motor a very slight deminution of speed occurs allowing more current to flow in the armature, and consequently the horse power becomes greater.

This automatic speed regulation is what is needed where a great many small machines are run from one motor or where it is necessary that a constant speed be maintained. It must be remembered that the field strength of this machine is always constant so that the losses due to field current consumption and eddy currents in the armature are practically the same at no load or light load as they are at full load, and when the machine is overloaded the field is not as strong as it should be to produce high efficiency and to reduce the danger of sparking.

I have seen a shunt motor stop under an excessive overload because the field was not strong enough to hold the great strength of the armature.

Fig. 1 shows a diagram of the shunt motor, the two mains come to the terminal *A* and *B*, wires *C* and *D* lead to the shunt field winding, the resistance of which always being the same and the potential at the terminal always being constant. Of course the current flowing through that will be constant which consequently gives a constant field strength. Now, if the brushes were not on the commutator the field current of say 5 ampers would be the only current flowing and the ammeter *A* would register this current. The volt meter *V* placed across the terminals reads 110 volts. This exciting current is always a dead loss although necessary in every machine. Now, if we place the brushes on the commutator and start the armature, more current will flow and this must be enough to overcome the friction of the barings and commutator and hysteresis of the iron in the armature. This current may be 4 ampers which added to the 5 ampers field current makes the ammeter read 9 ampers, all of which is a dead loss as the motor is yet doing no work. The efficiency therefore is zero. Supposing now we throw on a light load about one horse power. This will consume about 8 ampers of current which added to the 9 ampers makes 17 ampers resting on the ammeter, 9 of which are lost and 8 are doing work. The efficiency now is about 46 per cent. If one horse power more is added the ammeter will read 25 ampers, 9 of which are lost and 16 are doing work. The efficiency now is about 64 per cent., so it is thus evident that as the load increases to full load the efficiency becomes higher. Now, if the machine is overloaded the field strength remains the same as it was with no load. The field is weak and the neutral point for the brushes becomes changed, as it often does between no load and full load by the heavy currents in the armature acting on the field. Hence causing sparking and incidentially low efficiency.

A compound motor, although not so constant in speed, is more flexible in its regulation of speed and power. Although I will not go into the minor principles of the compound motor it will be well to consider the series motor, as the combination of its winding with the shunt winding makes the compound winding. The best and most common example of a series motor is the ordinary street railway motor. Here it is necessary to run at all speeds. Its flexibility is easily studied while riding on a car. It starts easily and gradually accelerates running at all speeds with a gradually changing torque. If after running along a level road where it is doing little work it comes to a hill the motor gradually slows down adjusting itself to the work it can do, thus avoiding undue loading and a burn out. The reason for this is that the field strength changes directly as the current in the armature, and as the speed of the armature is dependent on the strength of the field, the speed changes with the load.

Fig. 2 shows a series winding on a motor. *A* and *B* are the terminals. You will notice that as the brush is connected directly to the field winding all of the current must flow through the field. If the motor is run on a light load as a car on a level road, the armature will take a small current, consequently the field will be weak and the armature will run at a high speed, but if the car comes to a hill more work is thrown on the motor and more current flows through the armature. The field is strengthened and the speed of the armature decreases each one in its turn so that the motor does only the work it is capable of doing. Of course, the motor running on the hill is doing more work than it would on a level road because it is taking more

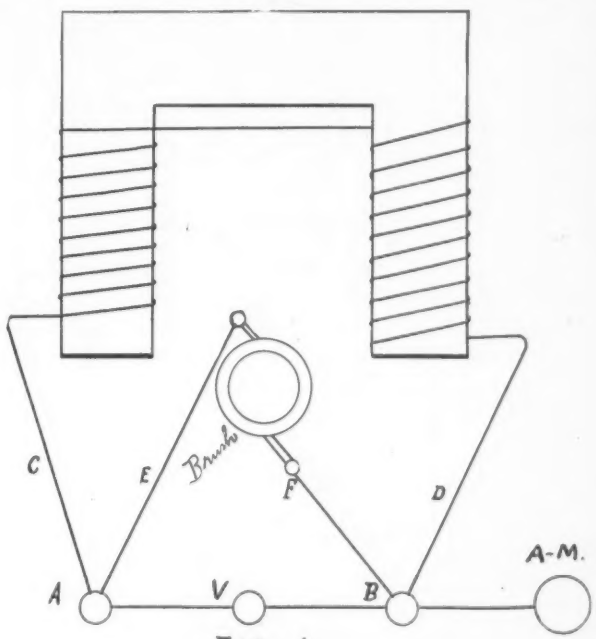


Fig. 1

current, but if it were shunt wound, or so constructed that it would run up the hill at the same speed as it did on the level it would consume an enormous current and be burned out in a short time. The principle uses for the series motor are street railways, traveling cranes, and fan motors. A compound motor is simply a combination of the merits gained from the two windings.

For most purposes, as direct connection of motors to machinery of different kinds, for running shops, etc., it would be impossible to run a series motor as the speed is never constant. The compound motor possess the advantages peculiar to both series and shunt machines. Its shunt winding governs the speed and its series winding gives it flexibility. The compound motor will be seen in Fig. 3. The fine shunt winding is connected between the terminals *A* and *B* the same as in Fig. 1, and the current through this winding will be constant tending to make the strenght of the field constant, and also the speed of the machine. If the brushes were taken off of the cummutator the

ammeter *A* will read about 3 ampers. The volt motor *V* reads 110 volts. The field of course will not be as strong as that in Fig. 1. Now, if we place the brushes on the commutator and start the armature, the current, about 3 ampers, that flows through

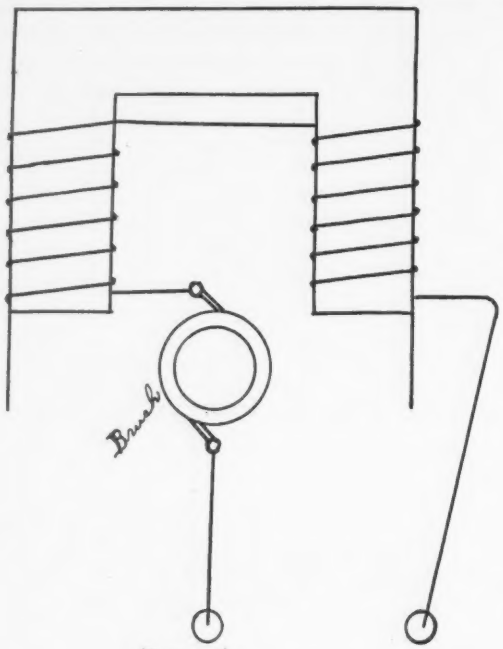


Fig. 2.

the armature also flows through the course series winding (similar to that in Fig. 2, but not so many convolutions) and increases slighlty the strength of the field. Even now the field is not as strong as that in Fig. 1, and consequently the armature

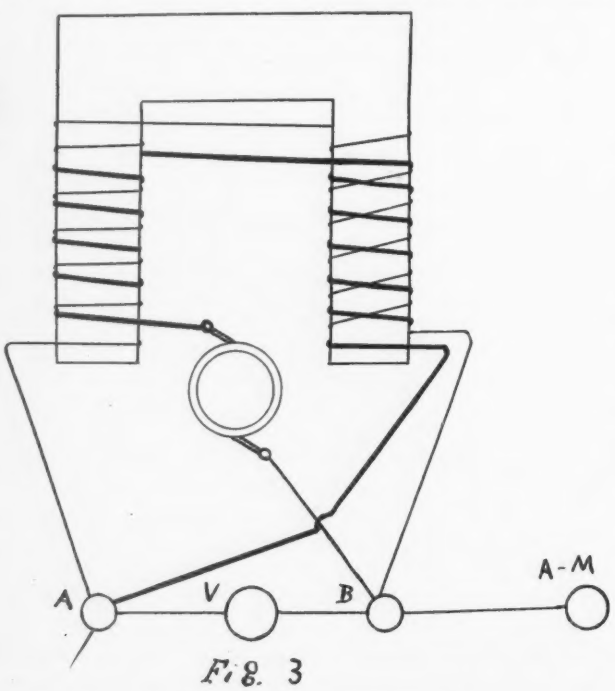


Fig. 3

runs more rapidly. The ammeter now reads 3 ampers flowing through the shunt winding plus the 3 ampers flowing through the armature making 6 ampires, all of which is dead loss, but is less than the ampers consumed by the shunt motor in Fig. 1. Still the motor is doing no work. The efficiency is zero and the speed is little high. Suppose we now throw on one horse power of work which requires about 8 ampers, the ammeter will read 14 ampers, 6 of which is a loss and 8 is used in doing work. The efficiency is therefore about 57 per cent. against an efficiency of 46 per cent. in the shunt machine. As the load is thrown off the field becomes slightly stronger and consequently the speed of the armature decreases slightly, but the field strength tends to keep the neutral point where it was when the motor was run with a light load, and avoid sparking, and consequently a loss in efficiency. The sparking and overloading of the machine are much more to be avoided than low efficiency, as frequent repairs are very expensive.

The most desirable places for using compound machines are where motors are directly connected to a machine or running by belt, or any other medium, a single machine. It is realized by few, but nevertheless true, that a large per cent. of machinery, especially that containing reciprocating parts, such as lithographing presses, iron planers and shapers requires an enormous amount of power at certain points in their cycles, much more than is practical to equip a machine with a motor large enough to supply that power. If the motor is shunt and not large enough to deliver the maximum power required, it will be excessively overloaded at these points and spark badly. If it is compound it will be helped in various ways. First, the motor itself is capable of a greater overload. Second, both the machine and motor will slow down at the point of greatest work, thereby using some of their momentum as power to carry it over the peak of the work, then making it up when the work is light. The change of speed will never be noticed in the machine, in fact the whole motion will be more balanced and the wear and tear on machine and motor will be less. This same principle applies to all classes of work, and where absolutely constant speed is not necessary the compound motor will be found the most satisfactory.

A Plucky Engineer.

Certainly it takes nerve to rush into the face of a threshing belt and flying bits of broken machinery to shut off a runaway engine in order to save the lives of fellow workmen and the property of ones employers. At the electric light plant of the Southern Electric Company, Gray's Ferry Road, and Carpenter Streets, Philadelphia, on the 22nd of January, the main power belt, five feet wide and one hundred yards long, tore completely apart, this occured when the engine was running at its top speed. The break was accompanied with a shock that shook the building to its very foundations. The broken belt became entangled with the gigantic 28 foot fly wheel, which had attained a momentarily a dangerous speed in consequence of the sudden release, and the flying belt was fast reducing the entire plant to fragments when the engineer realizing that heroic measures were necessary rushed into the midst of the melee and stopped the engine.

The tear in the belt was caused through the breaking out of a portion of the pulley over which it ran ; a piece of the broken metal being fed in between the belt and face of the pulley where the broken edges of the metal cut through the leather, thus weakening it and causing it to tear compltely apart.

Switchboards, windows and dynamos were wrecked in the immediate vicinity of the fly-wheel, but fortunately no one was injured.

The officials of the company were loud in their praise of the plucky engineer, whose quick thought and prompt action prevented a much greater loss to them.

Old Friends in New Clothes.

By A. Edward Rhodes.

Part IV.

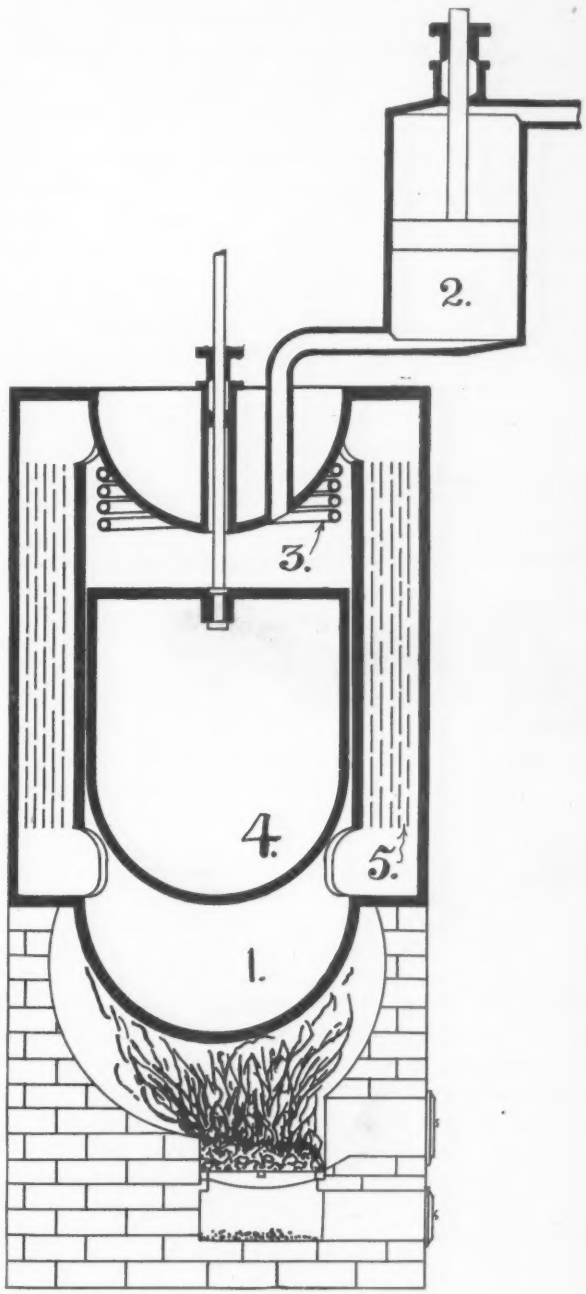
Hot Air Engines.

Most people are so used to steam engines, and more recently to gas engines, that that old reliable and economical user of coal for pumping purposes is forgotten, and in many cases where it should be best known, it is altogether unknown. I refer to the hot air engine, sometimes, though erroneously, called a caloric or heat engine. Strictly speaking, it should be called an external combustion engine to distinguish it from that class of engines in which the combustion which supplies heat occurs within a closed chamber containing the working substance. The ordinary coal-gas explosive engine is the most common type of internal-combustion engine.

Compared with an engine using saturated steam, air and gas engines have the important advantage that the temperature and pressure of the working substance are independent of one another. Therefore, it is possible to use an upper limit of temperature greatly higher than in the ordinary steam engine, and if the lower limit is not correspondingly raised, an increase of thermodynamic efficiency results. It is true, that the same advantage might be obtained in the case of steam, by excessive superheating; but this would mean, substantially the conversion of the steam engine into the type we are now considering, the working substance being then steam gas. The action of the air-engines, like that of all other heat engines, consists in admitting the air at a high temperature and pressure, worked expansively, and then it is either exhausted into the atmosphere and a fresh supply introduced, or it is again heated and compressed for a repetition of the former process. In the cycle just described, air has some advantages over steam as a working fluid. The efficiency of an engine depends upou the limit of temperature to which the working fluid is subjected, and it is practicable to use a higher working temperature with air than with steam, because there is no fixed relation between the temperature and pressure of air, as exists in the case of steam.

The Stirling engine is diagramatically shown in Fig. 1. The several parts are: 1 is a closed vessel containing air externally heated by a furnace beneath it. A pipe from the top of 1 leads to the working cylinder 2. At the top of 1 is a refrigerator 3, consisting of pipes through which cold water circulates. In 1 there is a displacer plunger 4 (or transfer piston), which is driven by the engine; when this is raised the air in 1 is heated, whereas when 4 is lowered the air in 1 is brought into contact with the refrigerator and cooled. On its way from the bottom or top, also on its way from top to bottom, the air must pass through an anular lining of wire-gauge 5. This is the regenerator. At the beginning of the cycle 4 is up. The air is then receiving heat and is expanding isothermally; this is the first stage. Then the plunger or transfer piston 4 descends. The air is driven through the regenerator 5, where it deposits heat, next the working piston makes its down stroke (in the actual engine the working cylinder was double-acting, another heating vessel, precisely like 1, being connected with the upper end of the working cylinder). This compresses the air isothermally, the heat produced by compression being taken up by 3. Finally the plunger 4 is raised, and the working air again passes through the regenerator, taking up the heat it left there.

In the actual forms in which Stirling's engine was used, the most important feature was that the air was compressed (by means of a pump) to a pressure greatly above that of the atmosphere. Stirling's cycle is theoretically perfect whatever the density of the working air, and compression in this case did not increase what may be called theoretical thermodynamic efficiency. It did, however, greatly increase the mechanical efficiency,



Fig'I.

and what is of importance, it increased the amount of power for a given size engine. To see this it is sufficient to consider that with compressed air a greater amount of heat is dealt with in each stroke of the engine.

To be continued.

The Practical Engineer.

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AMERICAN ORDER OF STEAM ENGINEERS
NEWS OF THE COUNCILS

One more new council of the A. O. S. E., in Philadelphia, during the past month and another new one already commencing to form.

The members of Lehigh Council, at Allentown, Pa., are preparing to show the officers and delegates to the next Grand Council session which meets there on the third Tuesday in March, a royal good time. All who can conveniently do so should be sure to attend this meeting, as it promises to be the best and most interesting in the history of the Grand Council. Moreover it will afford an oppertunity to visit one of the most delightful and prosperous communities in the world.

The newly elected officers of Old Colony council No. 14, of Rochland, Mass., the names of which were published in our January number, were duly installed by Deputy Supreme Chief, W. E. Packard and suite on Saturday evening, January 12, everything passed off pleasantly.

The seventeenth annual convention of the American Order of Steam Engineers, will be held in Reading, Pa., commencing May 12th next. It is doubtful if Supreme Chief Williams could have selected a more appropriate or fitting place from the many invitations received. Reading is a hustling manufacturing town of one hundred thousand inhabitants, and is situated in the wealthiest and most beautiful sections of Pennsylvania, bounded on the one side by the Schuylkill river and on the other by the famous Mt. Penn and Neversink mountains, it makes an ideal convention city, and indeed many of the largest sotiety conventions of recent years have been held there. Progress Council of the A. O. S. E., under whose auspices the convention will be held is one of the largest and best engineers associations in this section of the country and is amply able to do justice to the event.

THE NEXT CONVENTION
READING, PENNA.
Monday, May 12, 1902

Philadelphia, Jan. 24, 1902.

OFFICERS AND MEMBERS OF THE AMERICAN ORDER OF STEAM ENGINEERS.

Gentlemen and Brothers:

I take this time and opportunity to notify you in behalf of the Supreme Council that it has been my great pleasure to accept the cordial and generous invitation extended us by Progress Council, No, 13, of Pennsylvania, to hold our next annual session in the city of Reading, Pennsylvania, and do hereby officially announce that the Supreme Council will assemble at 10 o'clock A. M., Monday, May 12, 1902, in Deibert Hall, Ninth and Penn Streets, in said city, for the conducting of the business of the sixteenth annual session.

During the continuance of the session headquarters will be maintained at the American House, corner of Fourth and Penn Streets, where exceptional arrangements have been made for the comfort of all who attend.

A cordial invitation is hereby extended to all members of our order to be present at the session and assist in demonstrating our appreciation of the kindness and courtesy of Progress Council.

Fraternally Yours,
CLIFFORD P. WILLIAMS, Chief Engineer.

Convention of Pennsylvania Grand Council.

OFFICERS AND MEMBERS AMERICAN ORDER STEAM ENGINEERS, STATE OF PENNSYLVANIA.

Gentlemen and Brothers:

The Grand Council, State of Pennsylvania, American Order of Steam Engineers, will convene in annual session on Tuesday, March 18th, at 9 o'clock a. m., sharp, in Lawfer's Hall, 633 Hamilton Street, Allentown. All officers and delgates will please endeavor to be present at the hour stated.

I trust that all Councils in the State will send representatives, as business of very great importance will be transacted.

Councils are requested to instruct delegates to prepare, in writing, such business as they may wish to present at this session.

A. P. DREISBACH, Grand Chief Engineer.

Columbia Council.

The officers of Columbia Council No. 18, of Columbia, Pa., which, though not large, is one of the brightest and most progressive councils in the State, were installed on Saturday evening, January 18, by Corresponding Engineer, W. J. Courtney, assisted by Past Chief Engineer, John Schlossman. Following are the names: Chief Engineer, R. K. Grosh; First Assistant, R. Beard; Recording and Financial Engineer, W. J. Courtney, 804 Walnut Street; Treasurer, John J. Nolte; Senior Master Mechanic, Amos Meshey; Junior

Master Mechanic, Amos Simmons; Inside Sentinel, John McLane; Outside Sentinel, Daniel Eckman; Chaplain, W. C. Hummell; Trustee, for six months, Ambrose Bartch; Trustee, for eighteen months, Cyrus Mathiol; Delegate to Grand Council, W. J. Courtney.

Boston Council, No. 4.

The large comodious hall at 724 Washington Street, Boston, where Boston Council No. 4 meets was "packed" on Thursday evening, January 9th, when the officers for the ensuing year were installed by Deputy Supreme Chief Engineer W. E. Packard and suite, who journeyed from Rockland for that purpose. The following are Boston No. 4's officers for 1902: Chief Engineer, Harry G. Black; First Assistant Engineer, A. R. Abbott; Recording and Corresponding Engineer, William T. A. Faulkner, 41 Worcester Square; Financial Engineer, C. Lockhart; Treasurer Engineer, James B. Merrett; Senior Master Mechanic, William L. McCullogh; Junior Master Mechanic, James Cols; Chaplain, Freelin C. Smalley; Inside Sentinel, John T. Dodge; Outside Sentinel, James Cochrane.

Southwark Council.

Grand First Assistant Engineer, William J. Gifford, assisted by Past Chief Engineer Wm. Pegg acting as Senior Master Mechanic installed the following newly elected officers of Southwark Council, No. 4, Philadelphia, on Monday evening, January 6th: Chief Engineer, Walter Sommers; First Assistant, Charles Meyers; Financial Engineer, F. R. Moore; Treasurer, William Small; Recording and Corresponding Engineer, J. C. McDowell, 1913 South 8th Street; Chaplain Engineer, W. Pegg, Jr.; Senior Master Mechanic, Lewis Covington; Junior Master, Mechanic, Wm. Harney; Inside Sentinel, Owen Higgins; Outside Sentinel, Wm. Conner; Trustee, Thomas Marshall, Delegate to Grand Council, Thomas Marshall, Jr.

Welcome Council.

Past Supreme Chief Joseph L. High, installed the following officers of Welcome Council, No. 2, Philadelphia, on Friday evening, January 17th: Chief Engineer, Paul Pieling; First Assistant, Jas. Goetz; Senior Master Mechanic, Max Baur; Junior Master Mechanic, Jos. Letz; Recording Engineer, G. Knoos; Financial Engineer, L. D. Woodington, Chaplain, John Holton; Inside Sentinel, H. W. High; Outside Sentinel, F. Haag; Trustee, H. W. High. Following the installation a banquet was served in the lower hall. All went home at a late hour but in a merry frame of mind.

Philadelphia Council, No. 7.

The following officers of Philadelphia Council, No. 7, were installed on Wednesay, January 8th, by Grand First Assistant Engineer Wm. J. Gifford, assisted by Past Chief Engineer Frank J. Cannon: Chief Engineer, Ole Hanson; First Assistant, Jas. J. Murphy; Senior Master Mechanic, Geo. Welock; Junior Master Mechanic, W. G. Richards; Corresponding Engineer, W. S. Wetyler, 3707 Aspin Street; Financial Engineer, Peter Hardman; Treasurer, John Currey; Inside Sentinel, Wm. Peerce; Outside Sentinel, Thomas Prescott; Chaplain, John J. Kelley; Trustee Clarence Muncy; Delegate to Grand Council, Chas V. Glenn; Alternate, Frank J. Cannot. The installation ceremonies were followed with brief addresses upon the good of the order by Supreme Chief William's and Grand First Assistant Gifford.

N. A. S. E. and A. O. S. E. Branches Consolidate and form Large Council of the American Order.

Down in Nashville, Tenn., the stationary engineers deserve great credit for the remarkable manner in which they have kept themselves abreast of the rapid advance of the South along industral lines. This they, of course, could not have done had they not been organized, and thus been able to render each other mutual assistance and support by exchanging opinions, and aiding each other to develope and enlarge upon new ideas and improvements in connection with their profession.

Formerly there was a branch organization of the N. A. S. E. in Nashville, then, some two years ago, a branch of the American Order was formed there, and competition being the life of organizations as well as of trade, both prospered. Finally of late, the leading members of both organizations reached the conclusion that they ought to consolidate and form one large organization, which, with their combined membership, would include practically all of the engineers of the city. But the question of a choice of orders then became the difficult question to decide, each organization held out for their own family tree. At last, after a deal of good natured bantering on both sides, it was desided to appoint committees from each organization to discuss the matter, and with full power to select a referee whose decision both organizations agreed unanamously to abide by. Mr. Joe Moorse, of the firm of Frank & Moorse, was finally selected as referee, and both sides went before him and presented their best arguments, together with copies of the constitution of each organization, and such other literature, including the official journals, as might assist him in reaching a fair decision. Mr. Moorse finally decided that Nashville No. 1, N. A. S. E., should surrender their charter, and at once become members of Enterprise Council No. 1, American Order of Steam Engineers.

Both sides are to be congratulated.

Oregon Council.

Oregon Council No. 1, of Grant's Pass, Oregon, has elected new officers for the ensuing term and they were installed by the Deputy Supreme Chief of the State on January 9th. William H. Kenney is Chief Engineer, and Benjamin F. Myrich Corresponding Engineer. We have not received the names of the other officers. The Council is reported to be flourishing. This Council now meets every first and third Saturday evenings at A. O. U. W. Hall, on Main Street.

Down by the Sea.

The new officers of Atlantic City Council, No. 4, of New Jersey, were installed on Saturday evening, January 11th, by Supreme Chief Engineer Clifford P. Williams, assisted by Past Chief Engineer Thomas Marshall, Jr., acting as Senior Master Mechanic. The names of the officers are as follows: Chief Engineer, R. Endicott; First Assistant, Wm. Fonden; Recordiwg Engineer, W. S. Price, Haddon Hall; Financial Engineer, W. H. Lee; Treasurer, R. S. Petersen; Chaplain, Ira Hardin; Senior Master Mechanic, John A. Best; Junior Master Mechanic, W. P. Gray; Inside Sentinal, Spencer Price; Outside Sentinel, Wm. Greesman; Trustee, Warren Morris; Delegate to Supreme Council, A. M. Plummer. After the officers were inducted into their various stations remarks were indulged in by a number of

the visiting brothers and newly installed officers. The visitors complimenting the Council in the highest terms. Adjournment was then taken and all hands repaired to the Grand Central Hotel where a most excellent supper was in waiting. Brother Wm. Fonden made an efficient and interesting toast master. Mayor Stoy was present and delivered a short but interesting speech. Brief speeches were also made by Supreme Chief Williams, Past Supreme Chief Franklin R. Moore, Supreme Recording Engineer Fred W. Moore, Past Grand Chief of Pennsylvania, Jas. L. High, Past Chief Engineer J. Hamilton Myers, Thos. Marshall and others. The visiting engineers all remained over night and spent Sunday at the shore; all voting the Atlantic City boys the best of good fellows.

Camden Council.

Supreme Chief Engineer Clifford P. Williams, assisted by Past Chief Engineer Stacy Cotton, installed the following officers of Camden Council, No. 3, of New Jersey, on Thursday evening, January 2nd: Chief Engineer, S. R. Middleton; First Assistant, Harry Delzeit; Corresponding and Recording Engineer, C. H. Pfeiffer, 571 Berkley Street; Financial Engineer H. R. Taliferra; Treasurer, Julius Abrahams; Chaplain, J. Kerney; Senior Master Mechanic, C. H. Harrigle; Junior Master Mechanic, S. Best; Inside Sentinel, W. Wensch; Outside Sentinel, H. Hewlings; Trustee, Joe Whitley; Delegate, H. R. Taliferra.

Maryland Council.

The list of officers of Maryland Council, No. 1 for the ensuing term are as follows: Chief Engineer, J. C. W. Schrier; First Assistant, Robert Auer; Financial Engineer, Noah Pierson; Treasurer, Peter Hagan; Chaplin, Thos Cameron; Corresponding and Recording Engineer, Wm. S. Smith, 116 West Lee Street; Senior Master Mechanic, L. Smithers; Junior Master Mechanic, F. Denton; Inside Sentinel, W. Johnson; Outside Sentinel, George Goodwin; Trustee, Chas. Ashley.

Energy Council.

The following officers of Energy Council, No. 2, of Baltimore, have been elected and installed: Chief Engineer, Phillip A. Kirkwood; First Assistant Engineer, J. W. Sabines; Recording Engineer; Thomas O. Daneker; Corresponding Engineer, Jas. H. Stallings, 3032 Dillon Street; Financial Engineer, Harry L. McGee; Treasurer, Chas. L. Schirmer; Chaplain, J. W. Norton; Senior Master Mechanic, Wm. A. Knouss; Junior Master Mechanic, Marion E. Payne; Inside Sentinel, Fred L. May; Outside Sentinel, Thos. Devaughn; Trustees, John W. Norton, William A. Knouss, James H. Stallings; Repsentative to Supreme Council, James H. Stallings; Alternate, Fred. L. May.

Pottstown Council.

Pottstown Council, No. 14, of Pennsylvania, is composed of a hustling enterprising lot of fellows who always keep their Council well up in the front ranks. They have elected and installed a most excellent lot of officers for the ensuing term as follows: Chief Engineer, Joseph Rhoads; First Assistant Engineer, Clayton Fink; Recording and Corresponding Engineer, H. L. Shirey, 362 Cherry Street; Financial Engineer, Harry Zollers; Treasurer Engineer, James Warmkessell; Chaplain, Toby Pierman; Senior Master Mechanic, Joseph Umstead; Junior Master Mechanic, Wm. Rickert; Inside Sentinel, Franklin Reinert; Outside Sentinel, Charles Quinter; Trustees, William Rickert and Joseph Rhoads.

Go to Southwark Every Monday Evening.

Southwark Council, No. 4, which meets at Eighth and Reed Streets, every Monday evening, has engaged Bro. Charles Cook, of Kensington Council, to give instructions on the black board at each of their meetings for the next three months beginning the first Monday in February. All members of the Council are especially requested to attend regularly during this period, and brother members of the order connected with other Councils are also invited, particularly members of the new Municipal P. F. D. Council, who can make it convenient to get off for an hour or so on Monday evenings. Brother Cook is an engineer of exceptional ability and his years of experience as instructor of Kensington Council has especially fitted him for the work that he has engaged to do for Southwark. All Philadelphia members of the order should make a special effort to be present at each meeting.

Another New Council of The American Order of Steam Engineers in Philadelphia.

New year's resolutions take many different, and often fickle forms, but one which is laudable in purpose, and praiseworthy in practice, was made by the engineers of Philadelphia's Paid Fire Department on the evening of January 1st, 1902, and it is not likely to go the way of the average new year resolution.

The fire engine engineers resolved to become members of the American Order of Steam Engineers, and on the evening above mentioned, Municipal P. F. D. Council, No. 20, was instituted at Girard Hall, Sixth Street above Girard Avenve, Philadelphia.

Fourty-five out of the fifty men in the department signing the application for the charter.

The installation ceremonies were conducted by Grand Chief Engineer, A. P. Dreisbach; Grand First Assistant, William J. Gifford; Grand Trustee, F. J. Armbruster; Supreme Treasurer, George W. Richardson; Supreme Corresponding Engineer, J. C. McDowell; Past Supreme Chief, Franklin R. Moore, and others.

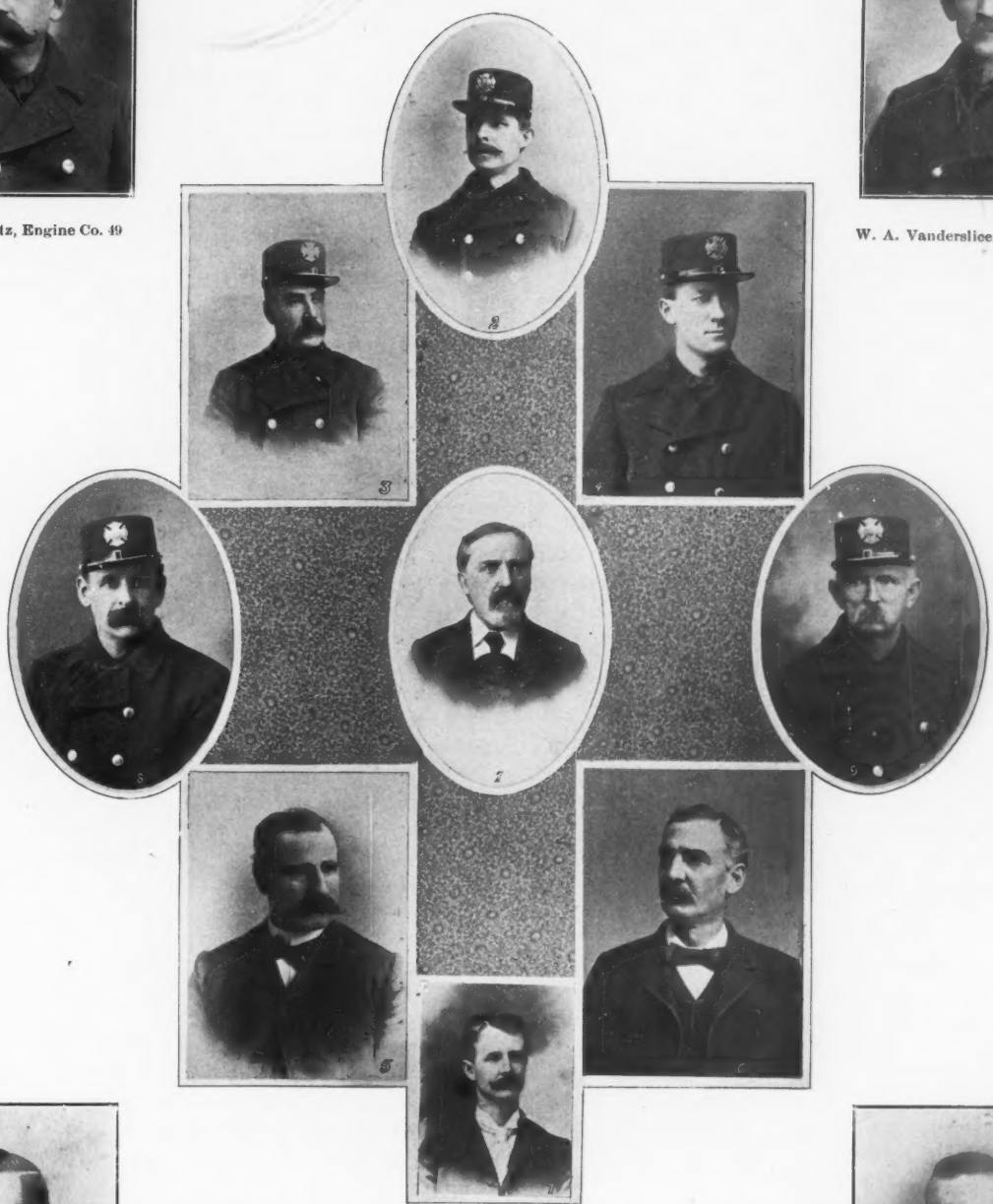
The "fire laddies" were all in the best of spirits, and the affair went off "swimmingly." The election of officers resulting as follows: Senior Past Chief Engineer, Frederick Markoe; Junior Past Chief Engineer, Edward F. Hall; Chief Engineer, Frederick Markoe; First Assistant Engineer, Daniel Bunting; Financial and Treasurer Engineer, Michael Hartman; Recording and ,Corresponding Engineer, Walter Meyers, 1211 North Howard Street; Chaplain, Charles J. Jones; Senior Master Mechanic, Harry Lutz; Junior Master Mechanic, Samuel Potts; Inside Sentinel, P. M. Collins; Outside Sentinel, William Robertson; Delegate to Grand Council, Frederick Markoe.

The organization of the fire department engineers of Philadelphia is not a new idea, they having maintained an independent coalition for some years past. They have at all times been in accord with the A. O. S. E., this feeling finally resulting in their commendable desire to become members of the order in fact, and thus be enabled to enjoy the rights and privileges of the order.

There is little doubt, however, but that their strongest reasons for the change was that they might be able to attend other local councils, and thus participate in the educational advantages, thereby keeping in closer touch with their chosen profession.

Harry Sponholtz, Engine Co. 49

W. A. Vanderslice, Engine Co. 29



Wm. Robertson, No. 11

2. Edward F. Hall, Engine Co. 10
3. Wm. Du Ross, Engine Co. 3. 4. Frank McMahn, Engine Co. 27
8. Wm. Robinson, Engine Co. 11 9. Samuel Potts, Engine Co. 33
1. Frederich Markoe, Engine Co. 35
5. Daniel Bunting, Engine Co. 18 Geo. W. Taylor, Engine Co. 17
7. Edward B. Orrell, Engine Co. 7

Some Prominent Engineers in Philadelphia's Paid Fire Department and Members of Municipal Council, P. F. D., No. 20, American Order of Steam Engineers

Henry C. Hicks, No. 20

The Use and Abuse of Valves and Cocks.

By W. H. Wakeman.

The ordinary plug cock has almost entirely disappeared from use as a blow off cock for our steam boilers, in this vicinity at least, which leaves us no cause for regret, as they were always troublesome and unsatisfactory. When one of them was opened it usually leaked around its stem, as it became heated by the passing hot water.

This was unpleasant while it was open and became intolerable when closed, therefore it was struck one or two blows with the most convenient hammer, piece of pipe or whatever might happen to be within reach. It was almost immpossible to open it again until the plug was struck on the bottom in order to loosen it.

The asbestos packed plug cock has superceded the plain specimen, and while it gives eminent satisfaction in many places, in others it is a failure. The first cocks of this kind that came to us were so designed that the plug could be given a complete revolution, therefore it was the practice of some engineers to open them sometimes in one direction and sometimes in the other, which caused them to leak, hence they were thrown out. Those found in the market now are so designed that the plug can be given ¼ revolution and no more, which is an improvement. Sometimes the plug turns hard so that it requires much strength to move it. Where this trouble is found, the cock should be relieved from pressure, the gland removed and kerosene poured in around the plug and allowed to stand until it penetrates and loosens the scale which has formed there, then it should be opened and closed several times before pressure is applied. The gland may then be put on and the nuts screwed down just tight enough to hold the packing and prevent leakage. I have cured a cock in this way that turned very hard, making it unsafe to open, as there was danger of failure to close it, after heat had expanded the metal.

Where a cock leaks around the plug the resulting rust should not be allowed to collect on the outside as it looks very bad and little work is required each day to keep it clean.

The plug cock is the same on both ends, therefore it may be used either way, but with a gate valve the case is different, for the side on which the joint is formed should be put towards the pressure. This seems contrary to the natural way, as the pressure then tends to force the disk away from its seat, while if the valve is reversed, the pressure forces the disk to its seat. An engineer in this vicinity proved this to his satisfaction recently, as his gate valve leaked when screwed on with the disk opposite to the pressure, but gave no trouble when reversed.

Where this type of vale is used on the blow off pipes, the stem should be horizontal, for if placed in a vertical position it gives dirt and scale a chance to lodge in the pocket below the disc and cause trouble. Some engineers seem to think that a gate valve is the only kind fit to use as a stop valve for the main outlet of a steam boiler, especially if the boiler is one of a battery. It is certainly a safe valve to use which is the most important point for consideration, but it takes time to open and close it, which is an objection, especially if an accident to some part of the piping makes it advisable to shut off steam as rapidly as possible. If a globe valve is attached so that when it is closed the pressure from the main pipe holds the disc to its seat, there seems to be no possible chance for failure.

Several men have been scalded while inspecting and cleaning boilers, because some ignorant and careless persons have turned steam into those boilers, not knowing that anybody was in them, but probably none have been injured by the failure of a valve.

The objection of putting on a globe valve so that the pressure will come on top of the disc when the valve is closed, is that the steam cannot be packed while pressure is on it. This is a good point, but on the other hand, packing lasts much longer where pressure is on it always, than where it is put on and shut off many times.

The best argument in favor of having the pressure come on top of the disc, is not on account of its greater safety, as valves seldom or never fail by stripping threads, but because, in many cases, they do better service in that way. When the pressure comes under a valve it may be tight when first closed but after water has collected under it, contraction caused by reduction of temperature may cause it to leak, while the pressure coming on top holds it to the seat regardless of expansion and contraction.

When a valve is wanted near a right angle turn in a pipe line, it is generally a good idea to use an angle valve instead of a globe or a gate valve, and an ell, as it calls for less joints to make and keep tight, and it makes a better looking job, also because less friction will be caused by water or steam passing through the line.

On pipe lines that are to convey superheated steam from one point to another, it is not wise to use valves with hard rubber discs in them as the heat will dissolve them in a short time. Use only brass or gun metal valves for such places or remove the hard rubber disc and substitute one made of bronze.

This does not necessarily mean that a separate superheating device is to be used in the plant, as some of the water tube or pipe boilers supply steam that is superheated enough to dissolve the best hard rubber disc now in the market.

Wherever these valves are in use an assortment of the discs should be kept in stock so that when one is wanted it can be put in at once. I have been surprised many times to note how this precaution is neglected. It may be caused by failure of the engineer to order what he needs, but usually it is due to the fact that the owner does not appreciate the necessity of getting supplies soon after they are ordered. It sometimes appears as if he expected to economize on supplies by postponing their purchase. The idea is correct, I am forced to admit, because they are not used unless they are somewhere to be found on the premises. More than once or twice an engineer has wasted steam that cost a dollar and a half because the owner or the superintendent would not buy a disc for a valve that cost ten cents. I am quite sure that the same kind of economy will be practiced again, but if any steam user allows it to happen after reading these lines, he will have the satisfaction of paying the bill.

Devices have been contrived for removing worn out discs, but the need of them is not apparent. A small cold chisel and hammer seems to answer every purpose for large valves, and when the bonnet of a small one is removed and the disc held in a gas jet for about two minutes it can be removed very easily with a stout knife.

The bonnets of large valves are usually held on with bolts, hence are easily removed, but small ones sometimes cause trouble, as the brass is soft, so that when an attempt is made to remove them the wrench rounds the corners off without removing the bonnets. The largest available wrench should always be used for such work, because a small one will spring and damage the bonnet more than a large one. Screw the jaws up as tight as possible then strike the handle a smart blow with the hand or a mallet.

When putting up steam pipes it is a good idea to remove bonnets from the valves, before putting them into service, then screw them back with force enough to make a tight joint, and no more. This will facilitate their removal when new discs are re-

quired as they are screwed down very hard in the shop where they are manufactured.

The bonnets and stuffing boxes of the valves in some plants bear "trade marks" made by Stilson wrenches which is evidence of carelessness or ignorance on the part of whoever did the work. I have sometimes found it necessary to take a Stilson wrench to remove a bonnet after all other means have failed, but always found time to file out the "trade marks" after loosening the stubborn thread.

The best and most convenient packing for valve stems is asbestos wicking coated with graphite, mixed with enough cylinder oil to make a stiff paste. If more than this is used it makes an untidy job.

This packing can quickly be made to fit any stuffing box and it will last as long as any packing should remain in use. When putting packing in the nut of a valve stem stuffing box it should be wound in the opposite direction from which the nut is turned when tightening it. When the nut is full screw it down tightly, then loosen it enough to allow easy movement of the valve stem.

After the stem is packed the wheel should not be turned down any more than enough to make the valve tight, when shut, and if it is to be left open it should be turned out as far as it will go, then reversed for about a turn so as to leave it loose in the bonnet. Sometimes valves are opened as wide as possible when cold, then as steam passes through the heat expands and holds the stems so that it becomes necessary to use a wrench to move them. This mistake is excusable once only.

No one thing gives a steam plant more of a dilapidated appearance than bent valve stems. When screwing valves into place it seems to be natural for some steam fitters to grasp the wheel and exert full strength upon it, thereby bending the stem, or to use it for a support when pulling on a pipe wrench, or even to step on it when climbing about, but it is much easier to bend a vale stem in this way than to straighten it again. It is almost impossible to make a good job without putting it in a lathe and taking a light chip off from it, which makes it small for the stuffing box nut, giving the packing a chance to work out around it, therefore it is much better to exercise care and thus avoid trouble of this kind rather than to find a remedy or to use crooked stems which cannot be kept tight.

A Locomotive Boiler Explosion at Macon, Ga.

On January 2d a locomotive boiler exploded in the shops of the Central of Georgia Railroad at Macon, Ga., causing the death of six persons and the serious injury of as many more, besides rendering great havoc to surrounding property. The details of the affair is most horrible, two of the dead having been blown completely into shreds.

At the time of the explosion the engine was in the shop undergoing repairs, one of which was the adjusting of the safety valve; it was during the adjusting of the valve that the boiler let go. The chief boiler inspector, Mr. McDonnell, and the fireman were instantly killed and four others died since from their wounds. So completely shattered was the boiler and engine that pieces were scattered all over the adjacent territory, and here and there a bone or a particle of brains or flesh added to the horrors of the wreck.

The general theory advanced by different engineers who viewed the wreck, is that it was necessary for the fireman to get up a pressure of 160 pounds in order to enable the inspector to set the valve at that figure. In trying to accomplish this in the quickest possible time he forgot to keep up his water supply.

In addition to that he had the blower on; finally, it is presumed that when he noticed how low the water was he immediately turned on the injector. The color and condition of the torn sheets of the boiler indicate that the metal had become overheated and the contact of the cool water did the "work."

This theory is combated by the railway officials, who say that such a condition could not have existed owing to the existence of a fusible plug. But it has been conclusively proved time and again that the fusible plug does not always work successfully, the plugs often becoming incrusted with rust and dirt and cannot be melted out.

Multiple Voltage Control in Direct Connected Transmission.

THE PRACTICAL ENGINEER:

With the introduction of motor driven tools as a method of eliminating the long and heavy line shafting, complicated belt drives, and troublesome countershafts, arises the ever important question of controlling these machines so as to produce the best results and highest efficiency for money expended. It becomes then a matter of great importance, first, to recognize that under all conditions the power generated and transmitted costs something, and secondly, that the power imparted or consumed by the motor has a value in proportion to the use made of it.

You will readily understand the value of electric transmission by considering the methods used at the present time for operating and controlling the power in connection with variable speed machines, of which there are two distinct methods, namely:

1. Direct connected transmission with rheostat control.
2. Direct connected transmission with multiple voltage control.

The first of the two methods is a system that was suggested as a means of controlling the motors applied directly to individual machines, and a general supposition was that the speed of the motor could be regulated or reduced to meet the various conditions of service by inserting an exte nal ohmic resistance in the armature circuit. This idea was never substantiated by facts.

It was found that while the motors would operate at practically the same speed under variable loads, when the speed of the motor was normal, the ohmic resistance introduced into the armature circuit destroyed proper regulation which could not be automatically controlled. Then in order to keep up a standard speed less than the normal speed of the motor, it was necessary to move the lever of the speed regulator or controller by hand each and every time the load changed on the motor and would make it very unsatisfactory, except, of course, where an attendant is always present, as for example, in operation of electric cranes, elevators, hoists, etc. But the speed control of the motor is not the most serious drawback in the use of regulating rheostats, for when the speed of the motor is reduced by resistance on the armature circuit, all current consumed in the resistance box is wasted and is very much like putting a friction brake on the fly wheel of an engine in order to vary speed, instead of adjusting the governor. Such practice as this means an enormous waste of current which must be dissipated in the rheostat, consequently the efficiency of a motor operated under these conditions falls considerably below that of a very poorly constructed line shaft and belt transmission. To bring this matter out more clearly it might be well to give the efficiency of a motor operated with rheostat control.

The motor referred to was running at a speed of 480 revolutions at normal speed and its efficiency at this speed and under

full load was about 90 per cent., at about 80 revolutions the efficiency of the motor was only 12 per cent., showing a difference of 78 per cent. efficiency loss in the rheostat. The above clearly shows that the rheostat is very unsatisfactory, namely, in its inability to regulate the speed ; and its inability to lower the voltage which it must do in order to obtain variation in speed without excessive loss of current.

Realizing the importance of the loss in current due to rheostat control, other methods were sought. All circumstances seemed particularly to invite the application of some system in which the speed of the motor could be controlled by the economical method of changing the voltage.

While this is not new, there are, perhaps, some features connected with it that are not fully understood. The system of multiple voltage control is one which is used to varying the speeds of the motor by supplying the armature circuit with different voltage while the fields are constantly excited from one constant voltage. The advantage of this system over the other, are first, it gives the motor a constant torque, regardless of speed ; second, when the motor is set to run at any one speed it

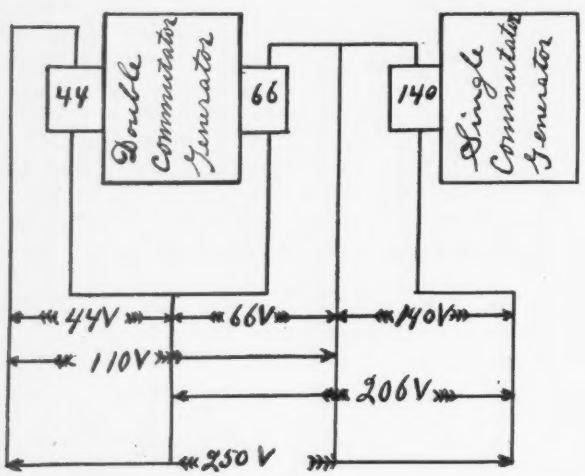


Fig. 1

will run at this speed, regardless of the load, and third, the different speeds are obtained without passing the current through any resistance. An important feature being that it requires no change whatever in the motor. To illustrate the method of supplying the different voltage, attention is called to the arrangements of the generators as shown in Fig. 1.

This consists of two generators, one with single and one with double commutators. The generator having two commutators is wound for furnishing 44 volts and 66 volts, and the single commutator generator is wound for 140 volts.

Now, if we connect our motor armature terminals across lines 1 and 2 the motor armature will receive 44 volts ; if connected across lines 2 and 3 it will receive 66 volts ; and if across lines 1 and 3, 110 volts ; 3 and 4, 140 volts ; if across 2 and 4, 206 volts, and if across lines 1 and 4 the armature will receive 250 volts, giving the motor six different speeds. The speed of the motor being almost in proportion to the voltage the motor will vary in speed in a ratio corresponding to 44 to 250. The diagram shown represents what is called a four wire system and constant speed motors would be connected between lines 3 and 4. By this system the motor would run at a fixed speed, regardless of the load, the torque of the motor would remain constant, regardless of speed, and the horse power would vary as the speed. The voltage is selected for the various speeds by means of a controller which may be reversible, thereby changing the rotation of the motor in either directions at will of operator.

ARTHUR G. HENRICKS, Milwaukee, Wis.

Items of Interest.

Among the railroads now using oil fuel extensively the most prominent are the Atchison, Topeka, Santa Fe and the Southern Pacific. Since the close of the year 1900 coal has been abandoned in favor of oil on all locomotives of the Atchison lines in California. This road, however, is much better situated with respect to coal than the Southern Pacific. The latter line of about 8000 miles lies almost entirely in the States of California and Texas and very near the oil fields of both. Because of the absence of coal deposits west of Sierra Nevada Mountains, coal is very expensive, averaging $4.03 per ton last year on the Southern Pacific. As this road used 1,629,459 tons of coal last year, the ultimate possible saving by using oil at present prices, may be conservatively estimated at between three and four millions of dollars per year, providing the supply is sufficient. This road paid $6,566,751 for coal last year, which was 30 per cent. of the cost of conducting its transportation. These figures indicate the importance of the new developments in oil for only one road, If the expectations with reference to the territorial extent of the newly found fields are realized, there may be a revolution in locomotive practice in a large and important section of the country.

EXPOSURE OF COAL.—Experiments made to determine the loss ensuing by exposing coal to the weather, unprotected in any way, show, contrary to general belief, that it is very small. There was a gain in the amount of oxygen but a loss of carbon, hydrogen and nitrogen ; the loss of calorific power was slight.

GAUGE GLASS BREAKAGE.—The breaking of gauge glasses under low presure seems unaccountable to the average engineer, and various reasons are advanced to account for it. It is probable that a few glasses break owing to inferior quality, but in the majority of cases the frequent breakage of the glass may be traced to one or more of the following causes : The lack of perfect alignment of the fittings. Faulty packing, the packing being either too hard when first applied or of a kind which requires undue pressure to prevent leakage. Improper methods of inserting the packing and tightening the packing nut and in using glasses which fit too snugly in the fittings.

The astonishing progress of electrial science during the past twenty years is admirably summed up in the "North American Review." Accustomed though we are to the marvelous achievements of applied electricity in recent days, the facts and figures set forth are a revelation. The amount of capital invested in electrical enterprises reaches stupendous totals, such as these : $250,000,000 in telegraphy, $400,000,000 in telephones, $750,000,000 in electric lighting, and $2,000,000,000 in electric railways, or a grand total of not less than $4,000,000,000 in electrical industries in this country alone, and an employment roll of 500,000 people. The next twenty years will see an advancement in the uses and appliances of electricity greater even than the two decades past.

Men who work in large factories seldom stop to calculate the immense amount of time lost when the power gives out, or for other reasons the business is suspended even for a few minutes.

A few figures, showing the magnitude into which small things may extend, will illustrate, to a startling degree, a fact which otherwise might not be noted. It will be remembered that during the funeral of our late President, the nation stood still for five minutes. Had the population of the United States been taken as one man, the time devoted to this silence is shown by the following figures.

Putting the population of the United States at 80,000,000, and supposing this vast population to be a single individual, that individual would have devoted an aggregate of 400,000,000 minutes to silence and mourning. That would be 6,000,000 hours, or 277,778 three-quarter days, or 39,635 half weeks. Estimating 30 days to a month, this would mean 9,259 quarter months. Could the aggregate time given by the entire population to its five minutes of hushed solemnity have been passed by a single individual, therefore, he would have stood in silent mourning no less than 771 years, 7 months and about one week.

LETTERS FROM ENGINEERS

In order to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories and general engine-room experiences are especially solicited.

The Working Principle of the Siphon.

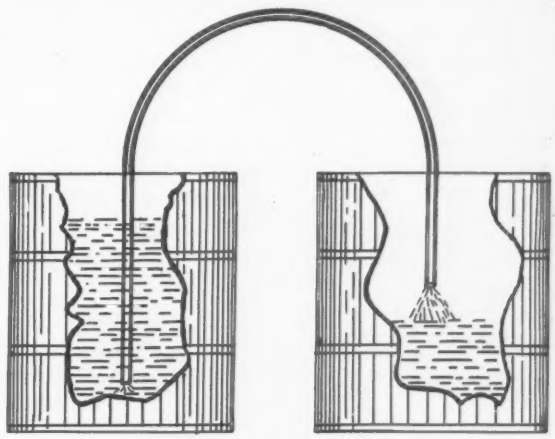
Editor THE PRACTICAL ENGINEER:

The recent discussion upon the siphon in the columns of THE PRACTICAL ENGINEER leads me to submit the following description of that method of lifting water as I understand it.

The earth is surrounded by a certain mixture of gases termed atmosphere, which attains, according to our most proficient scientists, a height of 45 to 50 miles.

Now, atmosphere like all other gases has a certain specific weight; as one ascends a mountain it can be rapidly observed that the density decreases and again upon approaching the base the weight is more appreciable, this is caused of course by the great volume of these gases pressing towards the earth upon the gravity principle (which is explained by Isaac Newton.) Hence the density of the air or atmosphere at a temperature of 32° Fahrenheit at sea level is found to support a column of mercury 30 inches in height in the Barometers. Now, mercury is rated at 0.49 pounds to the cubic inch; thus it will be readily seen that in supporting this column of murcury the atmosphere will have attained a density of $30 \times 0.49 = 14.7$ pounds, the average pressure which is at all times exerted upon the earth at sea level. Now, knowing that the ratio of 30 inches in height in the mercury is the same as 65.5 pounds per cubic foot, this extended in the air in a one inch column will be raised to the height of 33.87 feet. The very highest point possible for the siphon to operate is a little under this amount owing to friction in the pipes, in fact it seldom works above 30 feet.

In accompanying cut the siphon is clearly shown; let us take the discharge or short column first: In order to start the action it is necessary to create a vacuum in this pipe, this done and the atmospheric pressure upon the body of water into which the long column extends will, in an endeavor to fill the vacuum you have created, cause the two columns to fill with water to the height before mentioned. The continuous action of course is produced by the fall of the water from the short leg or column. This fall ceases when the water attains the same level in both tanks or in case the raise should be over 33.87 feet.



Siphon Fig. 1

This is true also of the suction of the pump. I at one time knew of an engineer who tried to siphon the water out of a shaft 57 feet in depth, this he could not do, and after considering the matter awhile he decided to install a pump there and "suck it out" as he termed it. You can imagine his surprise when upon turning on the steam he found the same condition to exist as that governing the siphon. This is merely a mechanical means of creating a vacuum in a pipe leading into the supply of water which is raised in the pipe (by outside pressure) to fill the vacuum thus created.

In this way it will become obvious to anyone that it cannot possibly reach a height greater than that possible to attain from the lifting power of 14.7 pounds, or the atmospheric pressure.

JOHN M. MUTER, Pittsburg, Pa.

A Letter of Thanks to The Practical Engineer.

EDITOR PRACTICAL ENGINEER:

The engineers of the bureau of fire feel thankful for your very able editorial which appeared in THE PRACTICAL ENGINEER of January 1, 1902, justifying them in their petition to City Councils for an increase of salary. We feel honored in having the influence of your journal exerted with Councils in behalf of the increase we have asked for.

Not wishing to intrude upon the valuable space in THE PRACTICAL ENGINEER, but deeming the time opportune to give a few statistics showing the justice of the claim as made by the engineers in the Department, Bureau of Fire, we present the following:

At the reorganization of the Fire Department in 1871, the following salaries were being paid :

Foremen . . .	$ 450,	they now ask $1,700.
Engineers . . .	1,000.	they now ask 1,400.
Drivers	750,	they now ask 1,200.
Tillermen . . .	770,	they now ask 1,200.
Hose and Laddermen	360,	they now ask 1,200.

Since the above period the foremen in the department have been granted an increase of 178 per cent.; the engineers have an increase of 9½ per cent.; fireman 15½ per cent.; tillermen 46 per cent.; hosemen 180 per cent.

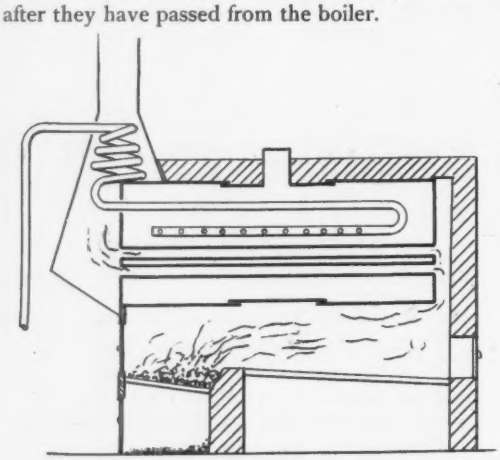
Respectfully Yours,

FREDERICK MARKOE, C. E., A. S. E.

A Unique Feed Water Heater.

EDITOR PRACTICAL ENGINEER :

I was glad to see that there is a new department,—"Letters from Engineers." This, I believe, can be made the strongest and most interesting feature of THE PRACTICAL ENGINEER, provided we engineers do our part. To do my share towards the success of this new department, I send a sketch of a feed water heater coil introduced into the stack, where it can take up heat from the hot gases after they have passed from the boiler.



Feed Water Heater.

I would ask the readers of THE PRACTICAL ENGINEER to tell me. Will this overcome the difficulties complained of in the article, "Method of Introducing Feed Water," page 6, January number? If so, why? If not, what are the objections?

READER.

The Acrobatic Feat of an Engineer.

EDITOR PRACTICAL ENGINEER :

While looking over a prominent Philadelphia morning paper to-day my attention was attracted by the following :

RENOVA, PA., Jan. 19th.

"The *safety valve* of the engine at E. F. Hall's saw mill, at Halls Run, got out of order last evening and the governor belt broke causing the engine to run the machinery so rapidly that a metal pulley flew into pieces. The flying pieces of the pulley cut the rafters causing the roof to fall. A circular saw was reduced to atoms. Finally the engine was torn from its foundation and started furiously around the mill smashing everything in its path until the *steam chest bursted.* The employes miraculously escaped. Mr. Hall jumped 15 feet breaking his right leg."

To the average newspaper reader this is doubtless an interesting bit of news, but it is somewhat perplexing to an engineer. I at first wondered why the editor did not send the article to his engine room for correction before printing it. Then I wondered as to the type of safety valve and its proximity to the governor belt in this case. It is quite common for safety valves to get out of order, but for them to affect the governor belt is a new wrinkle. Had the article read that steam escaping from an improperly adjusted safety valve had so moistened the governor belt that it failed to perform its proper functions, I would not have been surprised, but to hear that a *defective* safety valve had caused a governor belt to fail is quite miraculous.

I also wondered what kind of steam pipe was used in this plant, that it would permit the engine to go waltzing all over the mill in the manner described before breaking. S. L. H.

QUESTIONS AND ANSWERS.

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers with questions, he especially desires the readers in such cases to contribute any further information in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communications.

EDITOR PRACTICAL ENGINEER :

Will you please explain through your columns the reason for the priming or the foaming of the water in a boiler? At the plant where I am employed, this condition is so prevalent that it is often-times necessary to shut down in order to prevent injury to our cylinders. I know that most people attribute this condition to the presence of vegetable matter or mud, but in our case we use artesian well water which is as clean as water can well be. I should add, perhaps, that the scale formed, is of a whiteish color and will coat the boiler in a two month run to the extent of from ⅛ to ½ inch in thickness. PERPLEXED.

The conditions above mentioned undoubtedly are the results of a feed water highly charged with magnesia and salt. Magnesia is a fine, light, white powder, having neither taste nor smell, and is almost insoluble in boiling, but less so in cold water. Salt (chloride of sodium) is a natural compound of one atom of chloride and one of sodium. It occurs as a rock interstratified with marl, sandstone and gypsum, and as an element of salt springs, sea water and salt lakes. Any feed water containing a mixture of the above mentioned minerals will in a very short time cause the upper portion of a boiler to look like a whitewash receptacle, while the lower part will have a gray well-baked hard coating upon them, and is considered one of the worst possible forms of scale. This compound of minerals in the boiler is also productive of the worst kind of foaming. The condition is caused from the fact that during the action of the water turning into steam these minerals liberate upon the surface and being of an extremely light nature they form there a thick scum or film, this film during the process of steam making, acts in the measure of a compressor to the natural ebulition of the water, and as each globule raises to the surface, instead of gaining free access, it is restrained until such time as it is forced through the scum. In such cases this is always effected by a minature explosion; this throws a fine spray of water into the steam chamber of course, and eventually as scum increases so does the erruptions with the result of a supply of very wet steam (foaming). This cannot be stopped until you blow the boiler well down and admit plenty of fresh water. Where such a condition exists it is customary to use some sort of scumming apparatus or surface blow.

EDITOR PRACTICAL ENGINEER:

I am told in the study of electric lighting that a current of 16 candle power at 52 volts requires 1.04 amperes, and at 110 volts it takes 58 amperes. Now, I should like to know the reason for the condition at our plant here which is a 54 volt system, and they claim they have 600 16 candle power lamps when the am-meter registers about 27½ or 28 ampers. Please explain and oblige. A. EASTWOOD.

In answer to 'A. Eastwood' he states that they have in his plant a 54 volt system and that they have about 600 16 candle power lamps burning, also that his am-meter only registers 27.5 or 28 amperes; but he neglects to state whether the current is direct or alternating; if it is a direct current and the lamps are placed in multiple arc, the am-meter should register about 600 amperes, as a 3.5 Watt per candle power lamp would require, with 54 volt pressure, about 1 ampere each. If they are working under the above conditions undoubtedly their am-meter is badly out of order. If, however, they use an alternating current and converting 20 to 1, then the primary am-meter would register 30 amperes while 600 lamps of the above mentioned candle power are burning.

EDITOR PRACTICAL ENGINEER:

Please tell me through your columns what quantity of water will flow through a pipe ¾ inch in diameter under a pressure of 50 pounds per square inch. J. W. E., Oswego, Kansas.

As no given time is set for the flow, we will answer the minimum time in such matters and give the amount per second:

Q = quantity.
A = area of opening.
v = velocity of efflux.
h = head at above pressure.
Then Q = Av.
h = 115 feet.
Now $v = \sqrt{2gh}$. in which gravity = 32.16.
$v = \sqrt{2 \times 32.16 \times 115} = 86.05$.
$A = \frac{.752}{144} = .00391$ sq. feet.
$\therefore Q = .00391 \times 86.5 = 334555$ cwft. per sec.—EDITOR

EDITOR PRACTICAL ENGINEER:

I am running a battery of two boilers, using them alternately every time I change boilers the gauge glass on the one in which I am raising steam nearly always breaks. Will you explain the cause of this condition? W. L. B., New Iberia, La.

The glasses used to show the water line in the boiler are made of a soft glass known as "lead glass" and are easily cut or broken. If you are in the habit of cleaning the glass with a wire or other metalic device you may possibly scratch the glass, which usually results in a broken glass with the slightest change in temperature. It is more likely however to break through unequal expansion with the heating of the boiler; to avoid this we would advise you to open the drain cock quite often until the steam reaches the maximum pressure. Be sure and use soft rubber packing washers and ascertain before putting them into place that the glasses are ground square on the ends. Don't fit them too close, a little expansion room is necessary.

Note "Gauge Glass Breakage" elsewhere in this edition.

Editor THE PRACTICAL ENGINEER:

I have often heard the remark that to return the flue over the top of the boiler (in return tubulars), and to have the stack at the back of the boiler, would effect a saving of 20 per cent. of the fuel. This does not appear reasonable to me, and I am also donbtful of the safety of such an arrangement. Would some subscriber who has had experience with this idea give me his views?

Sudbury, Ont. E.

A New and Unique Profession.

Eighteen years of actual "field" experience in connection with the advertising departments of several leading trade publications has endowed Mr. Clarence P. Day with a practical knowledge of the subject of mechanical advertising, which amply justifies his claim to the title of Advertising Councellor, under which he has established offices at 253 Broadway, New York, and severed all other connections, to undertake a unique service for the advertising patrons of the mechanical press.

In this work Mr. Day enters a virgin field pregnant with opportunities. He will not conduct an agency or brokerage business, but will institute a new frofession as a student of advertising, and an adviser to produce higher efficiency, the client paying direct for the service rendered, thus relieving Mr. Day from obligations to the publisher.

Mr. Day's plan is sensible and comprehensive, and he posesses the ability to make it effective and beneficial to his patrons.

He has published a neat pamphlet, "Higher Efficiencies and Economy in Mechanical Advertising," which will pay, even a busy man, to read. A copy of this pamphlet will be mailed free to any advertiser.

The Eagle Pipe Wrench.

A new and exceedingly useful pipe wrench has but recently been put upon the market by the Frank Mossberg Company, Attleboro, Mass.

The wrench which is shown in the accompanying cut, is of a new and novel design and undoubtedly it will be found to be admirably adapted to a multiplicity of needs. It will be noticed by a careful study of the illustration that a hold can be taken upon a large number of various sizes of pipe with the greatest of ease.

The wrench is so constructed as to be readily fastened upon the pipe at almost any angle, and once caught the more pull exerted upon it the more tenacious is its hold, while the release is effected the moment the pull ceases, thus doing away with the usual trouble experienced in close quarters with many of the

ordinary wrenches in use at the present time. No adjustment is required as it is always ready for use on any size object within the limit of its range.

For those desiring a neat and effective article of this kind which can easily be carried around in the pocket, the company are making a special wrench; length, six inches; weight, eight ounces and will take any size pipe from ⅛ inch to ¾ inch in diameter.

A postal to the above mentioned address will ellicit a complete descriptive catalogue of the general output of the company in this line.

Trade Notes.

Mr. G. E. Tanbery has been engaged by the Bashlin Co., of Warren, Pa., to represent them in Philadelphia and vicinity.

The Pittsburgh Gage and Supply Co. reports a largely increased sale for their White Star Oil Filters; some recent sales of same having been made to the following parties:

Connecticut Railway and Lightening Co., Bridgeport, Conn
Watson & Stillman Co., New York.
Pittsburg Coal Co. (8 orders).
Manning, Maxwell & Moore, New York.
Donegan & Swift, New York.
National Steel Co., New Castle, Pa.
United States Steel Co. (12 orders).
Firth, Foster & Co., Philadelphia, Pa.
J. H. Mitchner & Co., Philadelphia, Pa.
W. W. Benson & Co., Philadelphia, Pa.
Kirshbaum & Co., Philadelphia, Pa.
Chester Lighting Co., Chester, Pa.
Harris & Algor, Shamokin, Pa.
Buffalo State Hospital, Buffalo, N. Y.
Boston Steam Specialty Co, Boston, Mass. (20 orders).
J. R. Vandyck Co. (14 orders).
Gates Iron Co. Chicago, Ill. (7 orders).
Yubari Mines, Japan (2 filters).

We are also experiencing a large inquiry and sale of our continuous oiling system in connection with special pattern White Star oil filters. Under this system, any number of engines may be lubricated, the filters being made suitable for various requirements, doing the work in a satisfactory manner, and occupying much smaller space than necessary with other oiling systems of this nature. These continuous oiling systems have been installed in the plants of the

United Electric Co., Newark, N. J.
U. S. Mint, Philadelphia, Pa.
Pittsburgh Railway Co., Pittsburgh, Pa.
Southern Traction Co., Pittsburgh, Pa.
Armstrong Cork Co., Pittsburg, Pa.
Boston Elevated Railway Co., Boston, Mass. (four orders).
Jones & Laughlins, Pittsburgh (2 plants).

We would be pleased to furnish circulars, blue prints, etc., descriptive of continuous oiling systems, and will, within a very short time, publish a handsome catalogue descriptive of the White Star filters, and also showing in detail the application of the White Star filtering system to various types of engines.

A sample can of Keystone Grease and a Keystone Brass Cup will be sent free of charge to any reader of The Practical Engineer upon request. To many this may seem like an unusual method of doing business, but the plan has been demonstrated to be successful by the fact that nearly every one receiving a sample of the grease finds it so valuable that they immediately order more.

Shaking Grates are usually preferred by the up to date engineer, shaking grates are like Sunday school superintendents, there are good ones and bad ones. The "Ajax" is a good shaking grate. It is manufactured by Mr. Charles Robson, 8th and Washington Avenue, Philadelphia. Mr. Robson is a grate specialist and can be depended upon to produce only the best. He also makes Herringbone, Tupper, Circular and various other grates. If you are interested write for a catalogue.

A sample bar of Stephen's Belt Dressing will be sent to any reader of The Practical Engineer free of charge. If you happen to have many belts under your charge it will pay you to take advantage of this liberal offer and give the dressing a fair trial. Address Stephenson Mfg. Co.. Albany, N. Y.

Thomas Walker & Sons, 4319-21 Tacony Street, Frankford, Philadelphia, were among the first to manufacture metallic packings in this country, and the magnificent success that they have attained is sufficient evidence of the value of the packing that they have placed upon the market. Many of their packings have been in use constantly for upwards of twenty years and are still working satisfactorily. A catalogue describing the packing and giving list of users will be sent free upon request.

If your are figuring upon installing an oil filter you will do well to write the Liberty Manufacturing Company, 5988 Centre Street, Pittsburg, Pa., for their catalogue and prices upon their "Famous Oil Refining and Purifying System." Their description of their system of oil filtering is well worth the trouble of investigation, as it is replete with much interesting data upon oil as well as containing some very handsome illustrations of their apparatus. A postal will assure you of one.

DO YOU KNOW

That we manufacture chemical water purifiers that are guaranteed to prevent and remove incrustation in steam boilers, no matter what its composition may be.

CHEMICAL PURIFIERS

that do this without injury to the boiler, its fittings or connections;

CHEMICAL PURIFIERS

that can be used with perfect safety in Breweries, Ice Plants, Dye Works and all places where the water of condensation is used for any purpose.

Write for terms, reports, circulars, etc. We interest you and pay liberal commission. Agents wanted everywhere.

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1720 N. 5th St. and 1711 N. Randolph St.
Philadelphia, Pa.

A Good Gauge Cock is just as desirable as a good boiler. A cock that constantly leaks reflects upon the engineer. The P. B. H. Diaphragm Cock is positively leakless. You can have one or more sent you on trial, to be returned if not better than any Gauge Cock that you ever used. Address Paul B. Huyette, 1245 Betz Building, Philadelphia.

Engineering Theory and Practice the latest book by the well known writer, W. H. Wakemen, is advertised on another page of this issue. This is a book without which no engineers library is complete. It is the work of a practical engineer written especially for practical engineers and its low price places it within the reach of all.

E. F. Houghton & Co., in their quarterly, "Paper Supplies," go to the greatest pains to present the various problems in their line in the most practical matter of fact way. The articles contained therein are from the pen of Mr. Chas. E. Carpenter, their general manager, who is noted for trying to teach his readers rather than trying to impress upon them that he knows it all. There is probably no subject upon which the average engineer is so ignorant as that of cylinder oil, yet in the April 1901 issue, Mr. Carpenter has treated that subject so ably that

Engineers, Electricians, Machinists: Secure subs for the "Power and Lighting Economist," Troy, N. Y. A quarterly review. Bright and helpful, $1. a year. Use idle hours to double your wages.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 440 Liberty Street, Allentown, Pa.

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Boiler Policies
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The Philadelphia
CASUALTY COMPANY
Provide full protection for injury to persons and damage to property from explosion at the lowest possible rates.
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116 N. BROAD ST., PHILA.

CLIFFORD'S CELEBRATED RING PACKING

For Steam Engines, Ice Machines and Brine Pumps
We guarantee 50 per cent less friction than any other packing
TRIAL ORDER FREE
If you will send us the diameter of rod and stuffing box we shall be glad to send you a trial order free of charge
R. F. CLIFFORD & CO., 15 Marshall St., Boston, Mass.

after reading it any engineer would become better versed on the cylinder oil subject than 99 per cent. of the oil men. January 1902 issue contains an article on the use and abuse of belting, which is marvelous in its simplicity. The illustrations in this article showing some 20 different methods of belt driving make it well worth having on file for reference. The last visit the representative of THE PRACTICAL ENGINEER made to Houghton's offices, showed some few copies of each edition still on hand, and Mr. Carpenter authorized the representative to say to the readers of THE PRACTICAL ENGINEER that they will be mailed free upon request to any of our regular subscribers. Be certain to specify April 1901 and January 1902 numbers. Houghton's address is on the front cover of this issue.

Frick's Pipe Clamps for stopping leaks in pipe joints are indespensable to large steam users or plants that cannot afford to shut down to repair a leak. They are decidly the most effective clamp made and can be applied almost instantly. For further information and prices write to Horace E. Frick & Co., 715 St James Street, Philadelphia.

Heating and ventilating is often a perplexing problem to engineers. Bower's Brothers & Co., 1029 Real Estate Trust Building, Philadelphia, are experts at that class of work. They will be glad to give advice to any one in trouble.

The Cling-Surface Mfg. Co. have sent out a very handsome calender which is dedicated to the A. O. S. E., and which they have supplied to all the Councils for use in their rooms. Extra copies can be had at their branch offices. They report larger sales for Cling-Surface during the past year than during any one preceeding.

Incrustation in steam boilers is a subject upon which all engineers posess some knowledge, but it is doubtful if any of us are as well posted upon this important feature of steam engineering as Mr. Geo. W. Lord, the famous manufacturing chemist and maker of Lord's Boiler Compounds. Any of our readers who are troubled with scale may obtain a share of Mr. Lord's knowledge by writing him for copies of the booklets and pamphlets that he is constantly issueing. Address Geo. W. Lord, 2238-2250 North Ninth Street, Philadelphia.

A handsome new calendar has been issued by the Kutztown Foundry and Machine Co., 700 Fidelity Building, Philadelphia. The striking feature of the calendar is a 10x13 engraving, showing a foundry scene, the light being reflected from the molten metal in the natural colors.

Through the generosity of the founders and of several prominent manufacturers the Trustees are able to award each year a limited number of

FREE SCHOLARSHIPS

In Mechanical, Electrical, Stationary, Locomotive, Marine, Textile

ENGINEERING

and Heating, Ventilation and Plumbing, including Mechanical Drawing

The free scholarships For 1902 Are Now Available and applications will be considered in the order received. Particular attention is called to the course in Electrical Engineering prepared for Stationary Engineers.

Further information and hand-book describing courses, methods and regular terms will be sent to any reader mentioning "The Practical Engineer."

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(Chartered by the Commonwealth of Massachusetts)
BOSTON, MASS., U. S. A.

STEAM ENGINEERING MADE PLAIN BY THE STUDY OF HAWKINS' WORKS.
BOOKS FOR ENGINEERS MACHINISTS ELECTRICIANS FIREMEN &C. ON THE STEAM ENGINE, INDICATOR, BOILERS, ETC. PRACTICAL BOOKS for practical men. Send for illustrated catalog.
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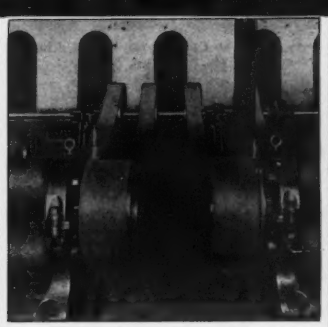
Cochrane Separators

Actually Saves Coal

Angle Receiver Type

They do this in a manner that is not always appreciated. The primary function of a Cochrane Separator, is, of course, to separate water from steam, and to thus prevent accidents to the engine; but in addition to this the removal of moisture very much reduces the amount of steam used by the engine, as it decreases the loss due to that wasteful phenomen on which experts call "cylinder condensation." Each particle of water in the steam in the cylinder absorbs heat obtained from the steam in contact with it—it cannot absorb this heat without taking it from the steam. As the steam is thus robbed of its heat heat it must condense, and when it is in that state it can perform no work.
Do not, therefore, allow water to enter with the steam, for our Cochrane Separators will prevent it.
Send for Catalogue 16-S.

HARRISON
SAFETY BOILER WORKS
3144 N. 17th St. Phila., Pa.



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YOU SHOULD READ
GRAPHITE FOR VALVES AND CYLNDERS

is the title of a little pamphlet that tells of the experience of engineers who have used graphite for better lubrication.

SUPPOSE YOU SEND FOR ONE?
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JOSEPH DIXON CRUCIBLE CO.
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American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them ; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

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Continued on page 26.

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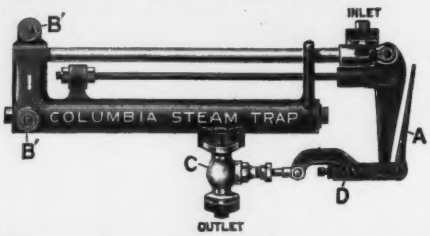

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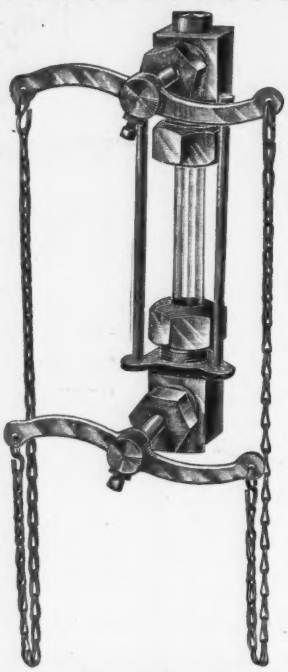

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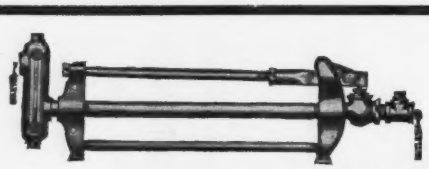

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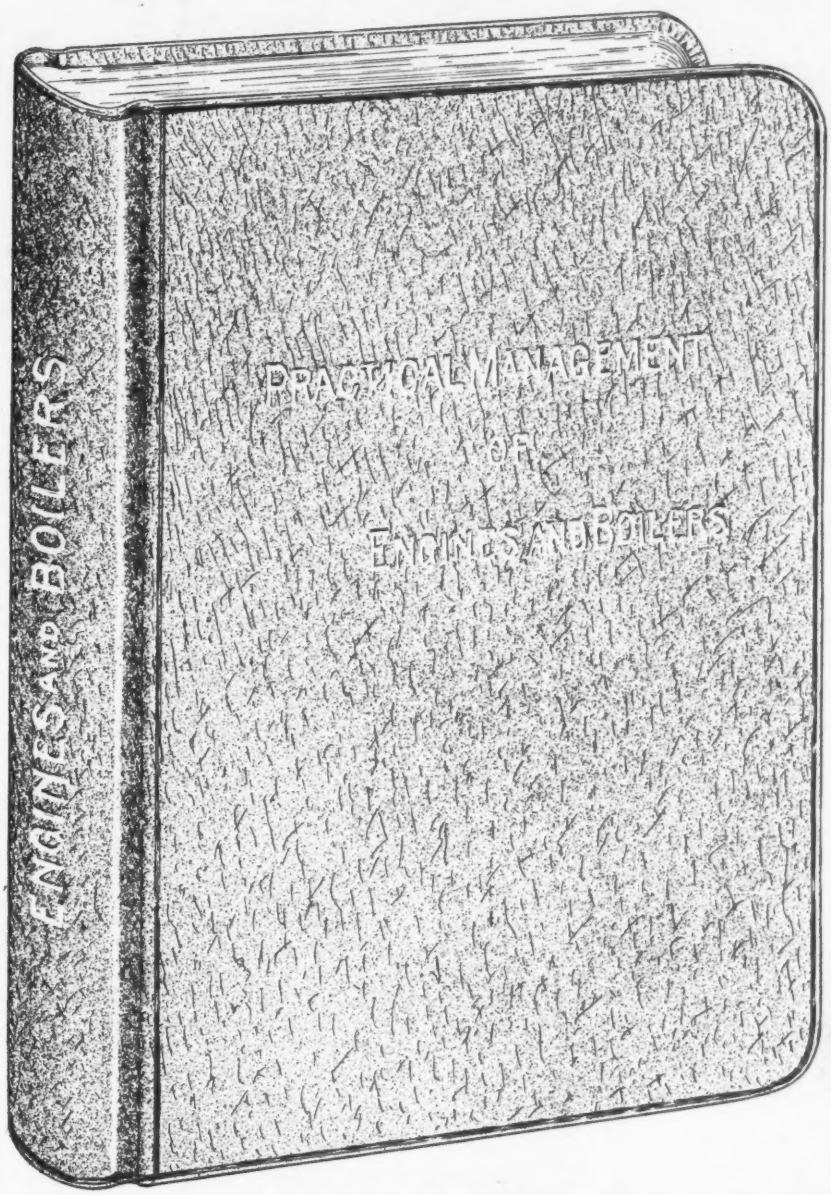

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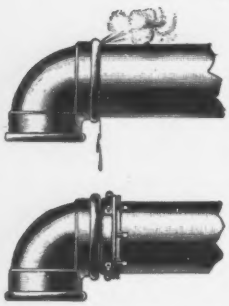

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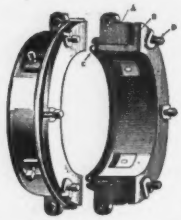

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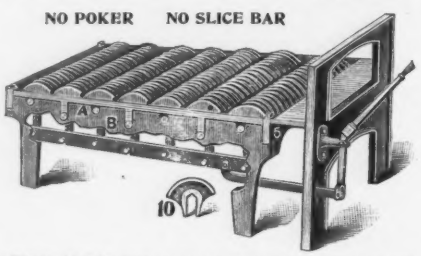

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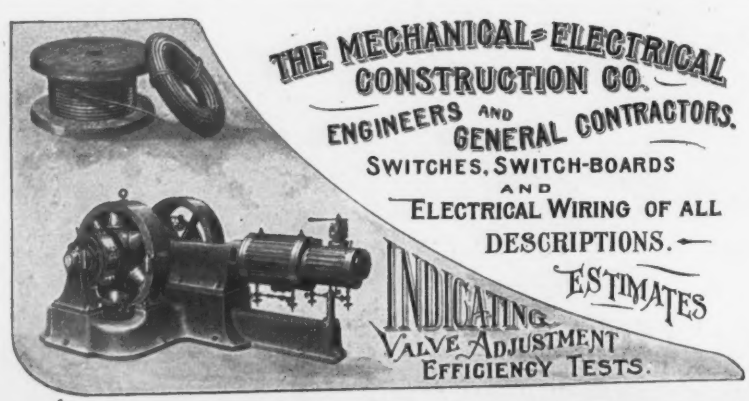
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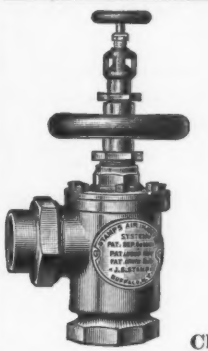

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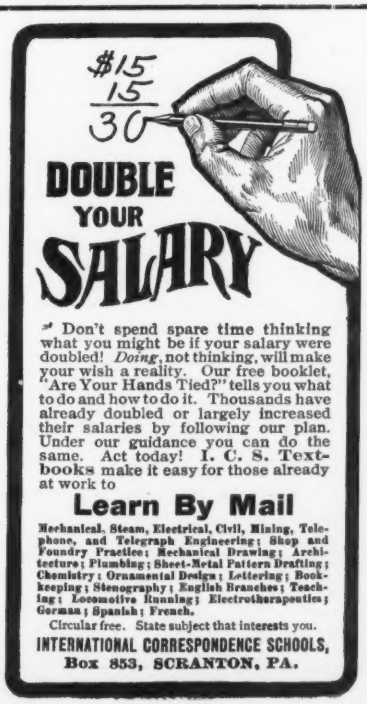

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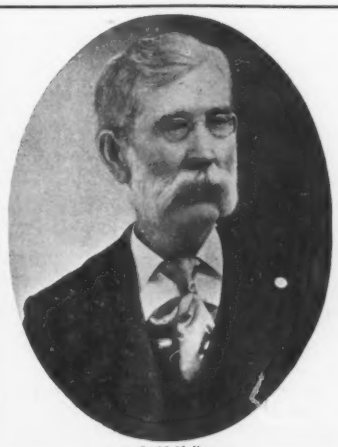

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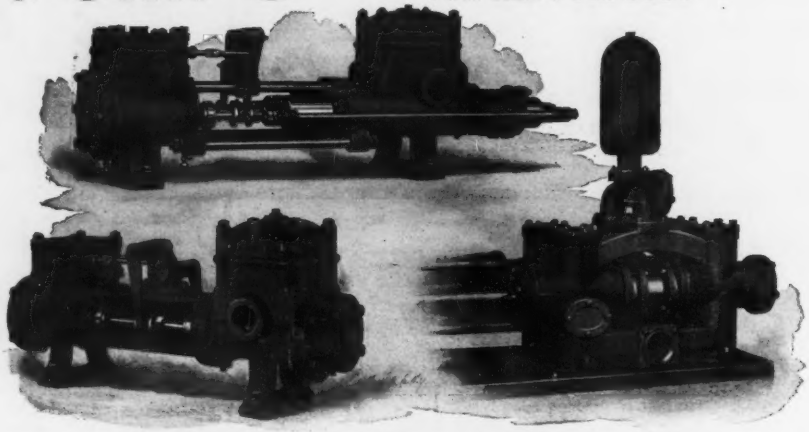

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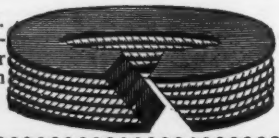

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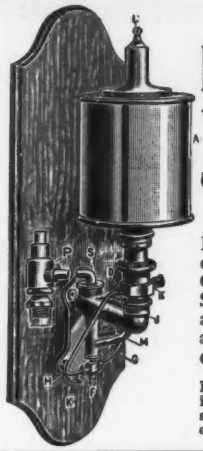

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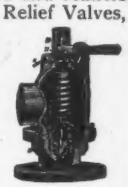

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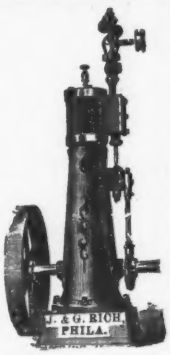

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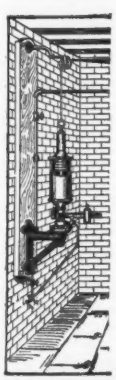

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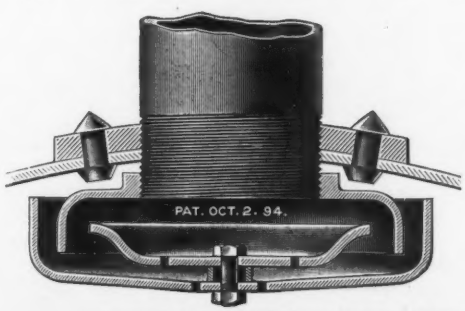

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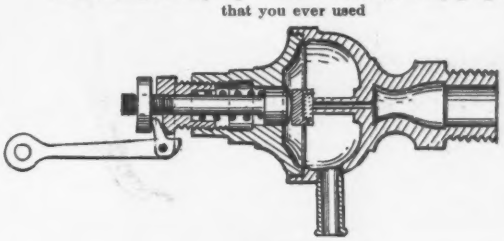

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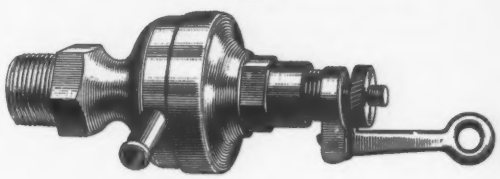

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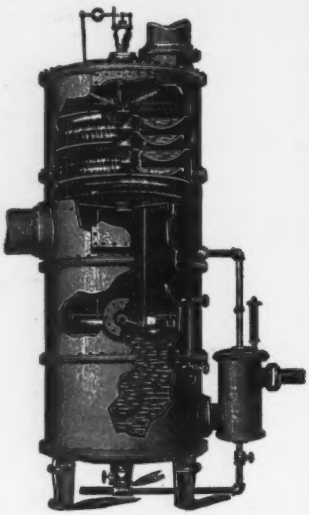

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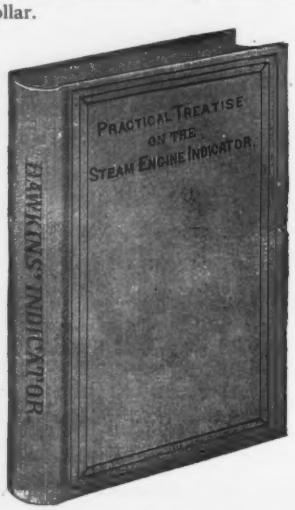

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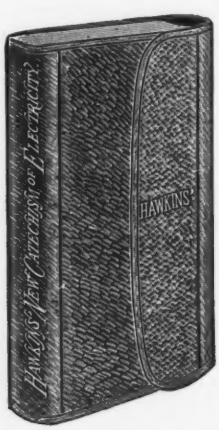

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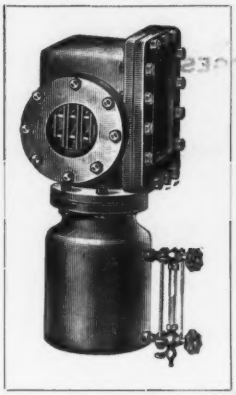

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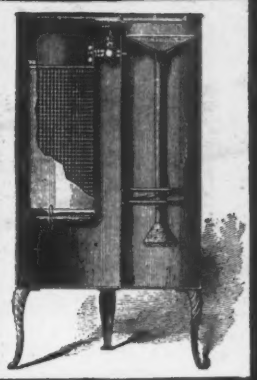

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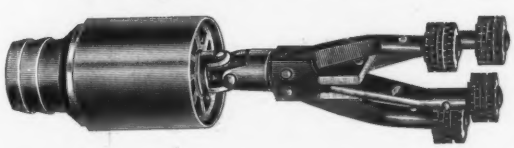

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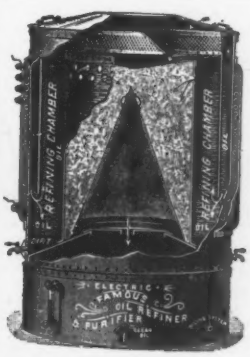

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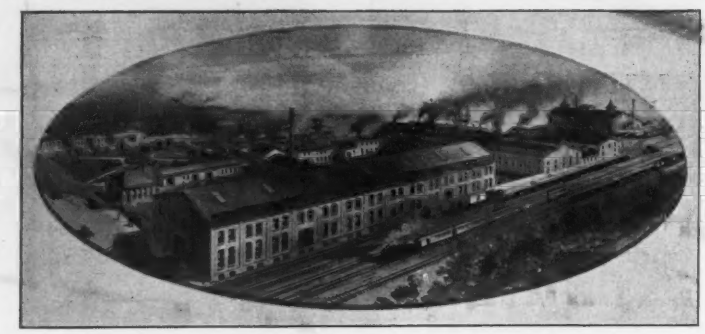

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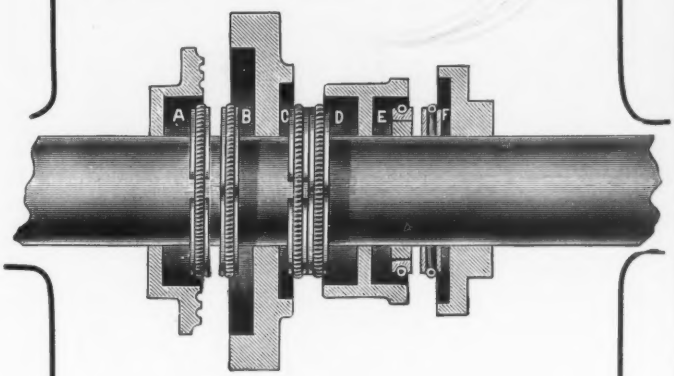

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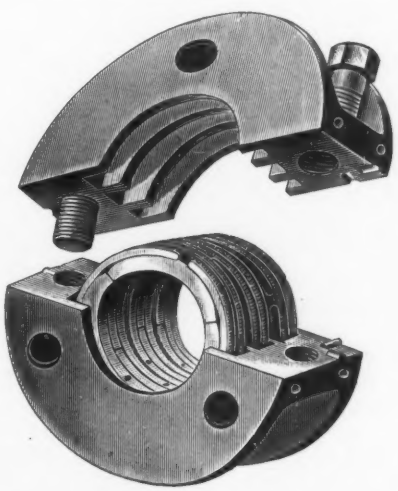

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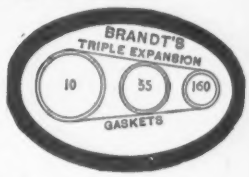

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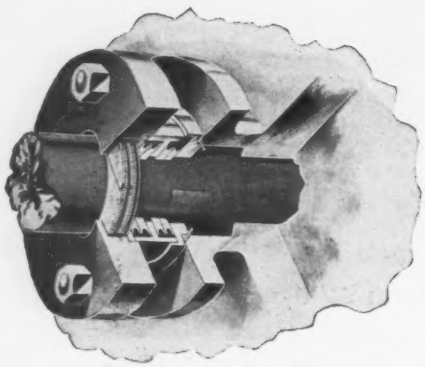

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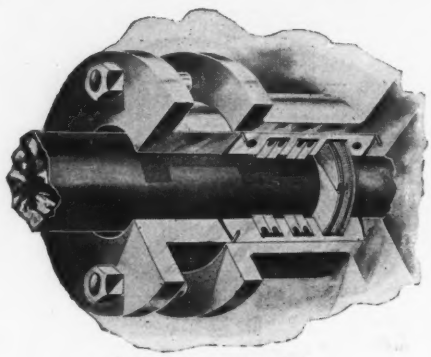

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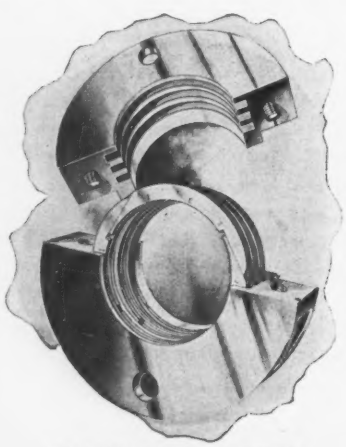

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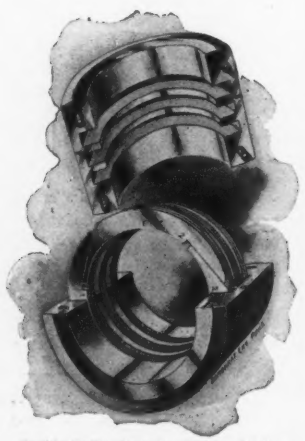

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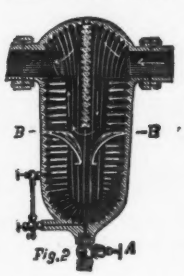

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Let every engineer make his own indicator book as he proceeds in his study and practice, and it will prove invaluable in after years. The present work has been compiled in this way, from data continually obtained during the author's professional career, extending over a third of a century.

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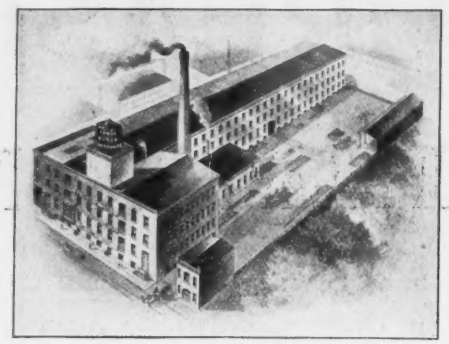

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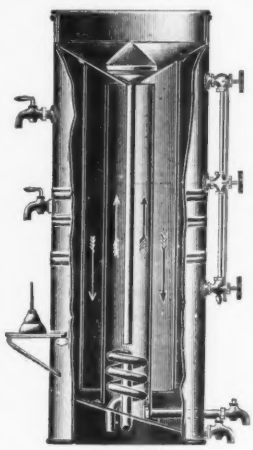

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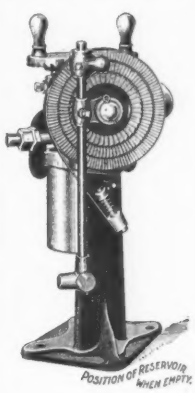

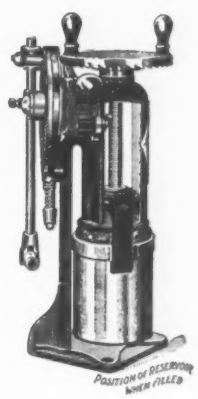

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